PRO SCIENTIA POPULIQUE SALUTE
LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
Purchased
1915
Septemb 1899 R. W. Gibson Inv.

THE

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND.

SECOND SERIES.

VOLUME THE SEVENTEENTH.

PRACTICE WITH SCIENCE.

LIBRARY
NEW YORK
BOTANICAL
GARDEN

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1881.

2nd Series

These experiments, it is true, are not easy; still they are in the power of every thinking husbandman. He who accomplishes but one, of however limited application, and takes care to report it faithfully, advances the science, and, consequently, the practice of agriculture, and acquires thereby a right to the gratitude of his fellows, and of those who come after. To make many such is beyond the power of most individuals, and cannot be expected. The first care of all societies formed for the improvement of our science should be to prepare the forms of such experiments, and to distribute the execution of these among their members.

Van Thaer, *Principles of Agriculture.*

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

CONTENTS OF PART I., VOLUME XVII.

SECOND SERIES.

APPENDIX.

DIRECTIONS TO THE BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume*: the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reprints of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

METEOROLOGY; IMPORTATIONS OF GRAIN; SALES OF BRITISH WHEAT; PRICES OF CORN AND OTHER PRODUCE; AGRICULTURAL STATISTICS; AND STATISTICS OF DAIRY PRODUCE.

[*The facts are derived chiefly from the Meteorological Reports of* Mr. Glaisher, *and the Returns of the* Board of Trade *and of the* Inspector-General of Imports and Exports.]

METEOROLOGY.—1880.

First Quarter (*January, February, March*).—The winter of 1879–80, like that of 1878–79, was exceptionally long and severe. January was exceedingly cold, with the smallest rainfall since 1826, very high barometer readings throughout the month, and an absence of strong winds. Several days toward the end of the month were distinguished by very low temperatures. February was warm, with a rainfall somewhat above its average, with high barometer readings during the first week, and low afterwards, and with strong winds occasionally. March was warm during the first half of the month, with frequent strong winds; from the 11th day the wind was mostly from the east, and occasionally the weather was cold; the rainfall was small, and the readings of the barometer were high, and constantly above their averages from the 5th day. The month was most favourable for agricultural work. The few days of warm weather with which the year 1879 closed, continued till the 5th day of January; the average excess of these five days was 6½°. On the 6th, a cold period set in, and continued to February 5th; the average deficiency of temperature for these 31 days was 5½°, and from February 6th to March 31st, the weather was, with few exceptions, warm, and the mean daily excess for these 55 days was 3°·2. The mean temperature at the Royal Observatory, Greenwich, was below the average during each of the 15 months ending January last; the mean of this cold period was only 44°·0, and was lower than in any previous corresponding period since 1813–15. There is, however, no previous instance on record of the mean temperature having been below the average for 15 successive months.

The *mean temperature* of the quarter was 39°·8, and exceeded the

average for the corresponding period in 109 years by 1°·0; the mean showed a deficiency in January of 3°·3, but exceeded the average in February and March by 3°·1 and 3°·2 respectively.

The *fall of rain* at Greenwich for the quarter was only 3·2 inches, or 1·8 inches below the average for the corresponding period of 65 years. The aggregate amount measured was 0·3 inches in January, 2·3 inches in February, and 0·6 inches in March.

The number of hours of bright sunshine recorded during the quarter at the Greenwich Observatory was 235·9, against 141·0 and 137·5 respectively in the first quarters of 1878 and 1879. There was a marked increase in the recorded amount of sunshine in each of the three months of the quarter.

Second Quarter (*April*, *May*, *June*).—The weather in April was variable. For a few days at the beginning of the month, the warm period which set in on February 6th continued, accompanied by strong S.W. winds. On April 6th the temperature declined below the average, the wind changed to the N.E., and remained there till the 16th; the wind then changed to the S.W., and the weather for a week was genial and warm; after this it suddenly became cold again, and the remainder of the month was ungenial, with strong N.E. winds. The month was showery, and the amount of rain was somewhat in excess of the average all over the country, but upon the whole it was a fine April month, very favourable for agricultural work, following, as it did, a dry March.

The first half of the month of May was cold; N. and N.E. winds, at times blowing very strongly, were prevalent till the 21st day; then S.W. winds prevailed till the 30th, and the wind was again N.E. on the last day. The weather was generally fine and dry, with occasional bright and warm sunshine, and there was very little rain. The nights were generally cold, the reading of the thermometer with its bulb on grass falling frequently below 32° at night.

At the end of the month vegetation was somewhat backward, but the prospects were considered favourable.

The month of June was unsettled; the first half was very cold, with strong N. and N.E. winds for a few days at the beginning; then there were S.W. winds, but the cold continued; then N. and N.E. winds again; from the 18th the winds were mostly from the S.S.W. and W.S.W., and the weather was warmer. Till the 26th, with the exception of three or four days, rain fell daily; from the 19th to the 26th, thunderstorms were frequent, with heavy rain and hail, causing much damage to crops.

At the end of the month, pastures and green crops looked well, having benefited a good deal by the frequent gentle rain, and

wheat, which came into ear, at many places, about the end of the month, was progressing favourably.

The mean reading of the barometer showed an excess in May, but was below the average both in April and June.

The *mean temperature* of the quarter was 52°·4, and was almost identical with the average for the corresponding period in 109 years. In April the mean was 47°·1 and 1°·0 above the average; in May 52°·6, and in excess by 0°·1; while it was 57°·5 in June, and showed a deficiency of 0°·7.

The *rainfall* at Greenwich during last quarter was 5·0 inches, and was nearly an inch below the average for the corresponding period in 65 years. Rain was measured on 40 of the 91 days in the quarter; the aggregate amount measured was 2·2 inches in April, 0·5 of an inch in May, and 2·3 inches in June. The rainfall showed a marked deficiency in May, and was but slightly above the average in April and June.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 457·8, against 486·0, 499·8, and 352·1 in the corresponding quarters of the three years 1877–8–9.

Third Quarter (*July, August, September*).—The weather in July was dull, unsettled, and wet in all parts of the country; in some places, rain fell on 26 and 27 days in the month, and at all places, excepting at the extreme south of England, the number of days of rain exceeded 20. Thunderstorms were of frequent occurrence. During the most remarkable storm in the month, viz., that of the 14th–16th, the fall of rain at Cardington, between 14th, 1 h. p.m., and 15th, 9 h. a.m., or in 20 hours, was 2·37 inches. At Stockton, near Rugby, on the 13th, the fall was still heavier.

Wheat crops were laid in many places, and at the end of the month, water stood on the land in low-lying districts, and rivers were full. The month was most unfavourable for harvest work. The fall of rain exceeded its average at all places, and by as much as 3 or 4 inches in some localities.

The weather at the beginning of August was cold, with frequent rain; on the 8th a favourable change took place, on the 9th the weather was fine in all districts, and from this time to the end of the month the weather was genial and fine; there was scarcely any rain, but there was an absence of bright sunshine; the wind was mostly from the N.E., and corn did not harden so quickly as desirable, but still very great progress was made in all harvest work. On the whole the month was remarkably fine.

In September very fine weather was prevalent during the first week, and the highest temperature in the year, at by far the

A 2

greatest number of places, was recorded on the 4th of September. Rain then set in, and from the 6th to the 21st fell on nearly every day. The heaviest falls were in the eight days ending the 18th.

No rain fell during the last week of the month, and the weather was fine and warm. The month, upon the whole, may be considered a fine one; and at the end of the month pastures and all root crops were reported in good condition.

The mean reading of the barometer was below the average during July, showed an excess during August, and corresponded with the average in September.

The *mean temperature* of the quarter was 61°·4, and exceeded the average for the corresponding period in 109 years by 1°·7. The mean was almost identical with the average in July, while in August and September the average excess was equal to 1°·9 and 3°·2 respectively.

The *rainfall* at Greenwich during last quarter was 8·8 inches, and exceeded by 1·4 inches the average amount in the corresponding periods of the preceding 65 years. Rain was measured on 41 of the 92 days in the quarter; the aggregate amount measured was 3·8 inches in July, 1·0 in August, and 4·0 in September. The rainfall was below the average in August, but showed a considerable excess in July and September.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 394·8, against 451·4 and 354·9 in the two preceding corresponding quarters.

Fourth Quarter (*October, November, December*).—The weather in October was cold and wet, this being in fact the coldest October since 1842, and the wettest on record at most places. Falls of rain exceeding one inch in 24 hours were unusually frequent. On the 20th, snow fell all over the country, but the fall was much heavier in the south than in the north of England: the direction of the wind was N., and the temperature of the whole day was 15° below its average. Between the 4th and 26th, the direction of the wind was mostly from E., N., or N.E.; only a few days about the middle of the month were fine.

In November, the first and third weeks were cold, and the second and last were warm; the weather was variable; on the 13th, the temperature for the day was 12¼° in excess of its average, and on the 22nd it was as much below its average. Rain fell on every day from the 8th to the 26th.

In December the weather was mild; there was no rain during the first half of the month, but the rain was nearly continuous from the 16th to the end of the year.

The mean reading of the barometer during the quarter corre-

sponded with the average in 39 years; the mean reading showed an excess in November, but was below the average in October and December.

The *mean temperature* of the quarter was 44°·0, and scarcely differed from the average for the corresponding period in 109 years; in October there was an average deficiency of 3°·4, an excess of 4°·2 prevailed in December, whereas the mean in November differed but slightly from the average. At 43 stations of observation, the mean temperature of the quarter ranged from 40°·0 in Carlisle, to 49°·6 in Guernsey, and 47°·3 in Ventnor. The thermometer at the Royal Observatory fell below the freezing point of water, on 3 days in October, 10 days in November, and 6 in December, in all, on 19 days in the quarter; the lowest reading on each of these 19 days showed an aggregate of 65°·3 of frost. In the last three months of 1878 and 1879, the numbers of frosty days were 27 and 37 respectively, and the aggregate degrees of frost 157°·9 and 249°·0.

The *rainfall* at Greenwich during last quarter was 12·8 inches, and exceeded by 5·7 inches the average amount in the corresponding periods of the preceding 65 years. The amount of rain measured during the quarter was 7·7 inches in October, 2·1 inches in November, and 3·0 inches in December; the excess was 5 inches in October, and one inch in December, while the amount was slightly below the average in November. Rain was measured on 18 days in October, 14 in November, and 15 in December; in all, on 47 of the 92 days in the quarter.

The number of hours of bright sunshine recorded during the quarter at the Royal Observatory, Greenwich, was 125·8, against 184·7, 157·6, and 138·3 in the three preceding corresponding quarters.

TABLE I.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1880.

1880. MONTHS.	Temperature of Air. Mean.	Air. Diff. from average of 109 years.	Air. Diff. from average of 39 years.	Evaporation. Mean.	Evaporation. Diff. from average of 39 years.	Dew Point. Mean.	Dew Point. Diff. from average of 39 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 39 years.	Water of the Thames.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 39 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 39 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
January ..	33·2	−3·3	−5·4	31·9	−5·2	29·5	−5·5	9·6	0·0	..	0·163	−0·038	1·9	−0·5
February ..	41·8	+3·1	+2·4	40·3	+2·7	38·5	+3·4	11·4	+0·2	..	0·233	+0·026	2·7	+0·3
March ..	44·3	+3·2	+2·7	41·8	+2·5	38·9	+2·7	16·2	+1·6	..	0·238	+0·023	2·7	+0·1
Means ..	39·8	+1·0	−0·1	38·0	0·0	35·6	+0·2	12·4	+0·6	..	0·211	+0·004	2·4	0·0
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
April	47·1	+1·0	0·0	44·1	+0·1	40·7	+0·2	16·0	−2·5	..	0·254	+0·001	2·9	−0·1
May	52·6	+0·1	0·0	48·3	−0·5	44·0	−1·1	21·8	+1·4	..	0·288	−0·010	3·3	−0·2
June	57·5	−0·7	−1·5	54·5	−0·1	51·7	+1·1	18·6	−2·5	..	0·384	+0·014	4·3	+0·1
Means ..	52·4	+0·1	−0·5	49·0	−0·2	45·5	+0·1	18·8	−1·2	..	0·309	−0·002	3·5	−0·1

NOTE.—In reading this Table it will be borne in mind that the *minus* sign (−) signifies *below* the average, and that the *plus* sign (+) signifies *above* the average.

TABLE II.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1880.

1880.	Temperature of										Elastic Force of Vapour.		Weight of Vapour in a Cubic Foot of Air.	
	Air.			Evaporation.		Dew Point.		Air—Daily Range.		Water of the Thames.				
MONTHS.	Mean.	Diff. from average of 109 years.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.		Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
July	61·7	+0·1	−0·4	58·4	+0·7	55·5	+1·6	19·1	−1·9	..	0·441	+0·024	4·9	+0·2
August ..	62·8	+1·9	+1·3	60·0	+2·6	57·7	+3·8	17·1	−2·7	..	0·477	+0·059	5·2	+0·6
September	59·7	+3·2	+2·6	57·1	+3·2	54·8	+3·8	17·5	−0·9	..	0·430	+0·052	4·8	+0·6
Means ..	61·4	+1·7	+1·2	58·5	+2·2	56·0	+3·1	17·9	−1·8	..	0·449	+0·045	5·0	+0·5
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	grs.
October ..	46·2	−3·4	−4·0	44·9	−3·2	43·4	−2·6	13·1	− 1·6	..	0·281	−0·032	3·2	− 0·4
November ..	42·5	+0·2	−0·9	40·5	−0·7	38·1	−1·2	12·0	+ 0·5	..	0·230	−0·015	2·7	− 0·1
December ..	43·2	+4·2	+3·1	41·7	+3·3	39·8	+3·3	9·8	+ 0·4	..	0·245	+0·027	2·8	+ 0·3
Means ..	44·0	+0·3	−0·6	42·4	−0·2	40·4	−0·2	11·6	− 0·2	..	0·252	−0·007	2·9	− 0·1

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE III.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE FIRST SIX MONTHS OF THE YEAR 1880.

1880.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was			Lowest Reading at Night.	Highest Reading at Night.
MONTHS.	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Amount.	Diff. from average of 65 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
January ..	86	− 1	30·204	+0·448	568	+15	0·3	−1·6	179	24	6	1	13·5	49·1
February ..	89	+ 4	29·634	−0·156	548	− 5	2·3	+0·8	346	13	12	4	18·0	46·9
March ..	81	− 1	29·937	+0·195	551	+ 1	0·6	−1·0	321	14	14	3	18·0	47·1
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	85	+ 1	29·925	+0·162	556	+ 4	3·2	−1·8	282	51	32	8	13·5	49·1
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
April ..	79	+ 1	29·701	−0·054	543	0	2·2	+0·4	333	6	20	4	26·4	45·5
May	73	− 3	29·910	+0·127	541	0	0·5	−1·6	281	11	12	8	22·8	47·0
June ..	82	+ 8	29·733	−0·075	531	− 1	2·3	+0·3	252	0	6	24	30·5	53·2
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	78	+ 2	29·781	−0·001	538	0	5·0	−0·9	289	17	38	36	22·8	53·2

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

TABLE IV.—METEOROLOGICAL OBSERVATIONS RECORDED AT THE ROYAL OBSERVATORY, GREENWICH, IN THE LAST SIX MONTHS OF THE YEAR 1880.

1880. MONTHS.	Degree of Humidity.		Reading of Barometer.		Weight of a Cubic Foot of Air.		Rain.		Daily Horizontal movement of the Air.	Reading of Thermometer on Grass.				
										Number of Nights it was			Lowest Reading at Night.	Highest Reading at Night.
	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Mean.	Diff. from average of 39 years.	Amount.	Diff. from average of 65 years.		At or below 30°.	Between 30° and 40°.	Above 40°.		
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
July	81	+ 6	29·727	−0·073	527	− 1	3·8	+1·3	258	0	0	31	41·8	56·8
August ..	83	+ 6	29·818	+0·035	527	− 1	1·0	−1·5	235	0	1	30	39·0	60·3
September	84	+ 3	29·805	0·000	530	− 3	4·0	+1·6	299	0	4	26	37·2	58·0
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	83	+ 5	29·783	−0·013	528	− 2	8·8	+1·4	264	0	5	87	37·2	60·3
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
October ..	91	+ 4	29·705	−0·001	544	+ 5	7·7	+5·0	269	8	16	7	24·0	49·2
November	85	− 3	29·793	+0·047	550	+ 2	2·1	−0·3	351	14	12	4	16·3	50·8
December	89	+ 1	29·748	−0·047	548	− 4	3·0	+1·0	352	10	16	5	22·7	46·6
							Sum	Sum	Mean	Sum	Sum	Sum	Lowest	Highest
Means ..	88	+ 1	29·749	0·000	547	+ 1	12·8	+5·7	324	32	44	16	16·3	50·8

NOTE.—In reading this Table it will be borne in mind that the *plus* sign (+) signifies *above* the average, and that the *minus* sign (−) signifies *below* the average.

CORN: IMPORTATIONS, SALES, AND PRICES.

TABLE V.—QUANTITIES of WHEAT, WHEATMEAL and FLOUR, BARLEY, OATS, PEAS and BEANS, IMPORTED into the UNITED KINGDOM in the YEAR 1880.

1880.	Wheat.	Wheatmeal and Flour.	Barley.	Oats.	Peas.	Beans.
	cwts.	cwts.	cwts.	cwts.	cwts.	cwts.
January ..	3,803,665	1,004,471	1,145,796	1,021,181	152,070	224,293
February	3,306,478	662,630	1,130,384	655,205	82,781	255,739
March ..	3,267,022	607,308	1,140,296	703,080	104,828	107,951
April ..	5,074,588	647,352	748,496	758,186	85,926	82,628
May ..	3,497,500	737,038	650,475	1,395,344	183,470	339,473
June ..	3,898,516	898,582	178,395	1,775,396	210,918	281,739
In first Six Months	22,847,769	4,557,381	4,993,842	6,308,392	819,993	1,291,823
July	5,016,049	849,345	355,013	1,426,514	130,765	262,270
August ..	7,189,026	860,672	193,842	2,080,873	68,750	160,473
September	7,036,478	963,697	1,202,005	1,093,677	115,795	140,171
October ..	3,305,823	801,282	1,512,657	956,009	334,907	129,024
November	5,255,882	1,294,922	1,962,228	1,047,802	429,893	240,480
December	4,546,277	1,263,283	1,465,940	949,163	241,335	350,518
In last Six Months	32,349,535	6,033,201	6,691,685	7,554,038	1,321,445	1,282,936
Year ..	55,197,304	10,590,582	11,685,527	13,862,430	2,141,438	2,574,759

NOTE.—The average weights *per quarter* of corn, as adopted in the office of the Inspector-General of Imports and Exports, are as follow:—For wheat, 485⅓ lbs., or 4⅓ cwts.; for barley, 400 lbs., or $3\frac{4}{7}$ cwts.; for oats, 308 lbs., or 2¾ cwts. Corn has been entered by *weight* instead of *measure* since September, 1864. No duty has been charged since 1st June, 1869.

TABLE VI.—COMPUTED REAL VALUE of CORN IMPORTED into the UNITED KINGDOM in each of the SIX YEARS, 1875-80.

	1875.	1876.	1877.	1878.	1879.	1880.
	£.	£.	£.	£.	£.	£.
Wheat ..	27,418,970	23,140,766	33,820,084	27,397,487	31,329,500	30,604,285
Barley ..	4,630,654	3,745,420	5,396,791	5,545,802	4,798,923	4,998,442
Oats ..	5,407,928	4,619,427	4,998,864	4,553,946	4,500,760	4,946,440
Maize ..	8,112,158	12,744,432	9,851,236	12,589,422	9,802,249	11,141,642
Other kinds	2,304,218	2,555,397	2,321,922	1,463,433	1,634,064	1,920,787
Wheat Flour	4,828,167	4,729,206	6,803,327	6,790,320	8,505,308	8,721,269
Other kinds of Flour	12,130	15,474	17,284	32,214	25,585	36,845
Total of Corn ..	52,714,225	51,550,122	63,209,508	58,372,624	60,596,389	62,369,710

TABLE VII.—QUANTITIES of BRITISH WHEAT SOLD in the Towns from which Returns are received under the Act of the 27th & 28th VICTORIA, cap. 87, and their AVERAGE PRICES, in each of the TWELVE MONTHS of the YEARS 1875-80.

	QUANTITIES IN QUARTERS.					
	1875.	1876.	1877.	1878.	1879.	1880.
	quarters.	quarters.	quarters.	quarters.	quarters.	quarters.
First month ..	210,661	154,367	152,557	146,848	183,223	124,422
Second month	223,974	188,539	173,729	164,387	237,861	142,857
Third month (five weeks)	292,172	208,367	213,718	174,025	234,469	136,613
Fourth month	233,970	160,868	150,012	146,933	197,918	106,170
Fifth month ..	234,683	174,153	132,231	166,909	227,295	104,125
Sixth month (five weeks)	216,016	188,611	122,390	137,981	229,307	127,132
Seventh month	121,684	90,626	77,674	82,597	105,139	71,622
Eighth month	135,456	88,030	89,759	119,611	71,525	54,641
Ninth month (five weeks)	199,314	314,327	225,659	272,699	75,374	153,752
Tenth month	226,503	216,393	217,046	329,564	96,261	197,757
Eleventh month	186,607	192,440	175,262	216,187	156,218	172,153
Twelfth month (five weeks)	234,035	225,254	212,627	276,943	207,511	218,641

	AVERAGE PRICES PER QUARTER.											
	1875.		1876.		1877.		1878.		1879.		1880.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
First month ..	44	4	44	11	51	7	51	11	39	3	46	2
Second month	42	3	43	4	51	8	51	5	38	0	44	0
Third month (five weeks)	41	2	43	1	51	1	49	8	39	7	56	5
Fourth month	43	0	44	11	53	4	51	3	41	0	48	2
Fifth month ..	42	5	45	0	65	10	51	11	40	10	45	4
Sixth month (five weeks)	42	2	47	0	64	6	48	0	41	8	45	1
Seventh month	45	3	48	6	62	9	44	11	44	6	43	9
Eighth month	52	4	46	4	64	11	44	7	49	4	44	0
Ninth month (five weeks)	49	3	46	8	59	1	44	1	47	7	41	9
Tenth month ..	46	1	46	7	53	7	39	7	48	10	41	4
Eleventh month	47	4	48	0	52	3	40	1	49	4	43	7
Twelfth month (five weeks)	46	4	49	9	51	6	40	8	46	7	44	2

Table VIII.—Average Prices of British Corn per Quarter (Imperial measure) as received from the Inspectors and Officers of Excise according to the Act of 27th & 28th Victoria, cap. 87, in each of the Fifty-two Weeks of the Year 1880.

Week ending	Wheat.		Barley.		Oats.		Week ending	Wheat.		Barley.		Oats.	
	s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.	d.
January 3..	46	11	37	7	21	7	July 3..	44	7	31	11	28	2
January 10..	46	2	36	8	20	11	July 10..	43	9	28	10	26	8
January 17..	45	11	37	2	21	1	July 17..	43	1	27	9	26	4
January 24..	45	7	37	3	20	10	July 24..	43	6	27	1	26	3
January 31..	45	3	36	4	21	11	July 31..	44	2	27	1	28	1
February 7..	44	2	36	10	21	3	August 7..	43	9	25	7	28	2
February 14..	43	7	36	10	21	1	August 14..	44	4	29	7	24	6
February 21..	43	1	35	11	22	2	August 21..	43	9	29	8	24	5
February 28..	43	0	35	2	22	3	August 28..	44	1	33	8	24	8
March 6..	44	7	34	2	22	4	September 4	43	3	35	0	22	11
March 13..	44	8	34	10	22	3	September 11	42	2	35	1	21	8
March 20..	46	1	34	11	23	3	September 18	39	11	33	5	20	7
March 27..	47	3	34	5	22	10	September 25	39	5	34	0	20	2
Average of Winter Quarter	45	1	36	0	21	9	Average of Summer Quarter	43	0	30	8	24	9
April 3..	48	4	35	0	22	6	October 2..	40	1	34	0	21	6
April 10..	48	2	33	9	23	5	October 9..	41	0	34	2	20	10
April 17..	47	11	23	8	24	6	October 16..	41	5	35	2	20	6
April 24..	48	1	32	8	24	11	October 23..	42	8	35	2	21	0
May 1..	45	9	33	6	23	6	October 30	43	7	35	11	21	8
May 8..	46	0	33	4	25	0	November 6	43	4	35	2	20	9
May 15..	44	9	32	2	24	11	November 13	43	5	34	7	21	5
May 22..	44	8	32	8	25	5	November 20	44	1	33	9	20	4
May 29..	44	11	30	4	25	1	November 27	44	5	33	6	21	5
June 5..	45	7	28	4	25	3	December 4	44	10	33	2	21	1
June 12..	44	11	32	0	26	5	December 11	45	1	32	8	20	9
June 19..	45	4	30	9	26	10	December 18	44	0	31	6	20	7
June 26..	44	8	28	3	26	9	December 25	42	8	31	3	20	3
Average of Spring Quarter	46	1	32	0	24	11	Average of Autumn Quarter	43	1	33	10	20	11

TABLE IX.—QUANTITIES of WHEAT, BARLEY, OATS, PEAS, BEANS, INDIAN CORN or MAIZE, WHEATMEAL and FLOUR, IMPORTED in the FOUR YEARS 1877–80; also the COUNTRIES from which the WHEAT, WHEATMEAL, and FLOUR were obtained.

	1877.	1878.	1879.	1880.
Wheat from—	cwts.	cwts.	cwts.	cwts.
Russia	10,838,000	9,032,930	7,975,144	2,880,108
Denmark	73,812	*	*	*
Germany	5,455,763	5,118,135	3,616,419	1,608,275
France	1,494,783	11,200	17,793	1,446
Turkey and Roumania	1,253,018	240,105	170,354	127,140
Egypt	2,447,709	217,498	2,064,397	1,590,957
United States	21,308,667	28,963,901	35,976,805	36,089,869
Chili	736,011	50,573	1,372,461	1,343,860
British India	6,104,940	1,819,304	887,256	3,247,242
Australia	425,697	1,459,850	2,245,657	4,267,743
British North America ..	2,912,178	2,603,586	4,676,686	3,893,544
Other countries	1,186,122	294,561	365,168	147,120
Total Wheat ..	54,162,888	49,811,643	59,368,140	55,197,304
Barley	12,970,751	14,162,028	11,541,098	11,685,527
Oats	12,925,604	12,765,789	13,482,607	13,862,430
Peas	1,511,846	1,804,733	1,916,777	2,141,438
Beans	4,573,482	1,870,508	2,310,101	2,574,759
Indian Corn, or Maize	30,455,681	41,631,348	36,078,586	37,153,658
Wheatmeal and Flour from—				
Germany	1,239,437	1,118,761	914,483	977,756
France	1,900,213	696,059	355,229	279,435
United States	1,771,558	3,635,200	6,863,172	6,908,352
British North America	254,695	294,448	460,435	521,702
Other countries	2,203,626	2,079,531	2,137,239	1,903,337
Total Wheatmeal and Flour	7,369,529	7,823,999	10,730,558	10,590,582
Indian Corn Meal	9,713	41,679	37,080	55,379

* Included under "Other Countries."

TABLE X.—AVERAGE PRICES of Consols, of Wheat, of Meat, and of Potatoes; also the AVERAGE NUMBER of PAUPERS relieved on the *last day* of each Week; and the MEAN TEMPERATURE, in each of the Twelve Quarters ending December 31st, 1880.

Quarters ending	AVERAGE PRICES.						PAUPERISM.		
	Consols (for Money).	Minimum Rate per Cent. of Discount charged by the Bank of England.	Wheat per Quarter in England and Wales.	Meat per lb. at the Metropolitan Meat Market (by the Carcass).		Potatoes (York Regents) per Ton, at Waterside Market, Southwark.	Quarterly Average of the Number of Paupers relieved on the *last day* of each week.		Mean Temperature.
				Beef.	Mutton.		In-door.	Out-door.	
1878	£.		s. d.						°
Mar. 31	95$\frac{3}{8}$	2·48	50 10	4$\frac{1}{8}$d.—8$\frac{1}{8}$d. Mean 6$\frac{1}{8}$d.	4$\frac{5}{8}$d.—9$\frac{2}{8}$d. Mean 7d.	188s.—212s. Mean 200s.	162,442	540,571	41·5
June 30	95$\frac{5}{8}$	2·85	50 2	4$\frac{4}{8}$d.—8$\frac{5}{8}$d. Mean 6$\frac{5}{8}$d.	5d.—9$\frac{4}{8}$d. Mean 7$\frac{2}{8}$d.	150s.—187s. Mean 168s.6d.	151,715	533,787	54·6
Sept. 30	95$\frac{1}{8}$	4·36	44 6	4$\frac{4}{8}$d.—8$\frac{2}{8}$d. Mean 6$\frac{3}{8}$d.	4$\frac{6}{8}$d.—9$\frac{2}{8}$d. Mean—7d.	120s.—151s. Mean 135s.6d.	145,956	513,616	60·8
Dec. 31	95	5·4	40 2	4$\frac{2}{8}$d.—7$\frac{6}{8}$d. Mean 6d.	4$\frac{7}{8}$d.—8$\frac{6}{8}$d. Mean 6$\frac{7}{8}$d.	111s.—132s. Mean 121s.6d.	159,721	523,996	41·6
1879									
Mar. 31	96$\frac{2}{8}$	3·38	39 0	3$\frac{7}{8}$d.—7$\frac{2}{8}$d. Mean 5$\frac{5}{8}$d.	4 d.—8$\frac{4}{8}$d. Mean 6$\frac{4}{8}$d.	118s.—144s. Mean 131s.	172,200	599,991	37·1
June 30	98$\frac{4}{8}$	2·05	41 2	4$\frac{1}{8}$d.—7$\frac{2}{8}$d. Mean 5$\frac{6}{8}$d.	4$\frac{6}{8}$d.—9d. Mean 6$\frac{7}{8}$d.	128s.—161s. Mean 144s.6d.	159,946	567,915	49·5
Sept. 30	97$\frac{6}{8}$	2·00	47 2	4d.—7$\frac{6}{8}$d. Mean 5$\frac{7}{8}$d.	4$\frac{5}{8}$d.—9d. Mean 6$\frac{7}{8}$d.	182s.—233s. Mean 207s.6d.	157,113	548,755	58·1
Dec. 31	98	2·60	48 1	3$\frac{6}{8}$d.—7$\frac{2}{8}$d. Mean 5$\frac{4}{8}$d.	4$\frac{4}{8}$d.—7$\frac{7}{8}$d. Mean 6$\frac{2}{8}$d.	136s.—160s. Mean 148s.	173,099	565,644	39·9
1880									
Mar. 31	98	3·00	45 1	4d.—7$\frac{5}{8}$d. Mean 5$\frac{7}{8}$d.	4$\frac{4}{8}$d.—8$\frac{2}{8}$d. Mean 6$\frac{3}{8}$d.	159s.—182s. Mean 170s.6d.	182,836	595,908	39·8
June 30	98$\frac{7}{8}$	2·93	46 1	4$\frac{2}{8}$d.—8$\frac{1}{8}$d. Mean 6$\frac{2}{8}$d.	5d.—9$\frac{3}{8}$d. Mean 7$\frac{2}{8}$d.	153s.—170s. Mean 161s.6d.	168,661	555,196	52·4
Sept. 30	98	2·50	43 0	4$\frac{2}{8}$d.—7$\frac{6}{8}$d. Mean 6d.	4$\frac{6}{8}$d.—8$\frac{6}{8}$d. Mean 6$\frac{6}{8}$d.	124s.—132s. Mean 128s.	162,879	539,670	61.4
Dec. 31	99$\frac{2}{8}$	2·62	43 1	4$\frac{7}{8}$d.—7$\frac{6}{8}$d. Mean 6$\frac{3}{8}$d.	5$\frac{2}{8}$d.—8$\frac{6}{8}$d. Mean 7d.	99s.—112s. Mean 105s.6d.	177,441	543,242	44·0

TABLE XI.—NUMBER of BEASTS exhibited and the PRICES realised for them at the CHRISTMAS MARKETS since 1843.

Year.	Beasts.	Prices.	Year.	Beasts.	Prices.
		s. d. s. d.			s. d. s. d.
1843	4,510	4 0—4 4	1862	8,430	3 4—5 0
1844	5,713	4 0—4 6	1863	10,372	3 6—5 2
1845	5,326	3 6—4 8	1864	7,130	3 8—5 8
1846	4,570	4 0—5 8	1865	7,530	3 4—5 4
1847	4,282	3 4—4 8	1866	7,340	3 8—5 6
1848	5,942	3 4—4 8	1867	8,110	3 4—5 0
1849	5,765	3 4—4 0	1868	5,320	3 4—5 8
1850	6,341	3 0—3 10	1869	6,728	3 6—6 2
1851	6,103	2 8—4 2	1870	6,425	3 6—6 2
1852	6,271	2 8—4 0	1871	6,320	3 10—6 2
1853	7,037	3 2—4 10	1872	7,560	4 6—6 0
1854	6,181	3 6—5 4	1873	6,170	4 4—6 6
1855	7,000	3 8—4 2	1874	6,570	4 4—6 8
1856	6,748	3 4—5 0	1875	7,660	4 6—6 6
1857	6,856	3 4—4 8	1876	7,020	4 4—6 4
1858	6,424	3 4—5 0	1877	7,510	4 6—6 0
1859	7,560	3 6—5 4	1878	6,830	4 6—6 0
1860	7,860	3 4—5 6	1879	5,620	4 0—6 4
1861	8,840	3 4—5 0	1880	7,660	4 0—6 0

TABLE XII.—AVERAGE PRICES of BRITISH WHEAT, BARLEY, and OATS, per IMPERIAL QUARTER, in each of the SEVENTEEN YEARS 1863–80.

Year.	Wheat.	Barley.	Oats.	Year.	Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.		s. d.	s. d.	s. d.
1863	44 9	33 11	21 2	1872	57 0	37 4	23 2
1864	40 2	29 11	20 1	1873	58 8	40 5	25 5
1865	41 10	29 9	21 10	1874	55 9	44 11	28 10
1866	49 11	37 5	24 7	1875	45 2	38 5	28 8
1867	64 6	40 0	26 1	1876	46 2	35 2	26 3
1868	63 9	43 0	28 1	1877	56 9	39 8	25 11
1869	48 2	39 5	26 0	1878	46 5	40 2	24 4
1870	46 10	34 7	22 10	1879	43 10	34 0	21 9
1871	56 10	36 2	25 2	1880	44 4	33 1	23 1

TABLE XIII.—ACREAGE under each Description of CROP,
GREAT BRITAIN and

DESCRIPTION of CROPS and LIVE STOCK.	GREAT BRITAIN.		
	1878.	1879.	1880.
CORN CROPS:—	Acres.	Acres.	Acres.
Wheat	3,218,417	2,890,244	2,909,438
Barley or Bere	2,469,652	2,667,176	2,467,441
Oats	2,698,907	2,656,628	2,796,905
Rye	60,117	49,127	40,781
Beans	437,936	444,228	426,667
Peas	282,617	277,831	234,470
TOTAL CORN CROPS	9,167,646	8,985,234	8,875,702
GREEN CROPS:—			
Potatoes	508,431	541,344	550,932
Turnips and Swedes	2,031,860	2,017,075	2,024,207
Mangold and Beetroot	343,389	363,561	343,116
Carrots and Parsnips	14,711	15,844	17,082
Cabbage, Kohl-rabi, and Rape	171,773	168,386	161,575
Vetches, Lucerne, and any other crop (except clover or grass)	420,846	448,108	379,741
TOTAL GREEN CROPS	3,491,010	3,554,318	3,476,653
OTHER CROPS, GRASS, &c.:—			
Flax	7,261	7,055	8,985
Hops	71,789	67,671	66,705
Bare fallow or uncropped arable land	632,423	721,409	812,566
Clover and artificial and other grasses under rotation	4,573,107	4,473,373	4,434,339
Permanent pasture, meadow, or grass not broken up in rotation (exclusive of heath or mountain land)	13,911,296	14,166,724	14,426,959
LIVE STOCK:—	No.	No.	No.
Cattle	5,738,128	5,856,356	5,912,046
Sheep	28,406,206	28,157,080	26,619,050
Pigs	2,483,248	2,091,559	2,000,842
Total number of horses used for agriculture, unbroken horses, and mares kept solely for breeding	1,412,502	1,432,845	1,421,180
Acreage of orchard, or of arable or grass-land, used also for fruit-trees	165,415	174,715	..
Acreage of woods, coppices, and plantations	2,187,078*	2,187,078*	..

* As returned

FALLOW, and GRASS, and NUMBER of CATTLE, SHEEP, and PIGS, in IRELAND, in 1878–80.

IRELAND.			UNITED KINGDOM, including the Islands.		
1878.	1879.	1880.	1878.	1879.	1880.
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
154,011	157,508	148,636	3,381,701	3,056,428	3,065,895
244,504	254,845	218,579	2,722,879	2,931,809	2,695,000
1,412,637	1,330,212	1,381,943	4,124,029	3,998,200	4,191,716
10,864	9,086	7,108	71,074	58,288	47,937
8,267	9,294	9,564	446,466	453,751	436,361
1,138	855	594	284,026	278,983	235,177
1,831,421	1,761,800	1,766,424	11,030,175	10,777,459	10,672,086
846,985	842,621	820,728	1,364,508	1,392,822	1,380,578
329,942	314,666	302,768	2,372,198	2,341,527	2,336,499
45,187	51,163	41,510	389,306	415,450	385,348
3,938	4,530	3,799	19,163	20,913	21,402
46,938	40,326	42,350	218,855	208,808	204,016
44,770	41,330	36,204	468,165	492,036	418,450
1,317,760	1,294,636	1,247,359	4,832,195	4,871,556	4,746,293
111,808	128,004	157,534	119,076	135,060	166,521
..	..	..	71,789	67,671	66,705
16,971	16,295	15,366	650,238	738,264	828,778
1,942,716	1,937,348	1,909,907	6,557,748	6,450,905	6,389,225
10,124,745	10,198,139	10,261,266	24,065,394	24,395,905	24,717,092
No.	No.	No.	No.	No.	No.
3,984,751	4,067,094	3,921,026	9,761,288	9,961,536	9,871,153
4,094,230	4,017,889	3,561,361	32,571,018	32,237,958	30,239,620
1,269,340	1,071,990	849,046	3,767,960	3,178,106	2,863,488
504,750	513,036	499,284	1,927,066	1,955,394	1,929,680
..	..	..	..	..	..
..	..	..	..	..	..

in 1872.

TABLE XIV.—CERTAIN ARTICLES of FOREIGN and COLONIAL PRODUCTION IMPORTED in the YEARS 1877–80; and their QUANTITIES.

	1877.	1878.	1879.	1880.
ANIMALS, Living:				
Oxen, Bulls, and Cows, number	174,023	226,455	208,720	350,950
Calves .. .. ,,	30,172	27,008	39,172	38,999
Sheep .. .. ,, Lambs .. .. ,,	874,062	892,126	944,869	940,991
Swine and Hogs .. .. ,,	20,037	55,911	52,267	51,030
Bones (burnt or not, or as animal charcoal) .. .. tons	104,223	85,773	65,067	79,740
Cotton, Raw .. .. .. cwts.	12,112,819	11,978,288	13,171,043	14,547,283
Flax .. .. ,,	2,216,267	1,553,664	1,694,051	1,896,249
Guano .. .. ,,	152,990	178,178	76,945	78,965
Hemp .. .. ,,	1,251,458	1,224,195	1,204,036	1,320,731
Hops .. .. ,,	248,620	169,512	262,616	196,688
Hides untanned: Dry .. ,,	551,547	565,909	545,373	660,198
,, ,, Wet .. ,,	594,542	595,221	463,086	584,693
Petroleum .. .. tuns	134,096	119,169	170,831	152,672
Oilseed Cakes .. .. .. tons	163,349	201,299	216,002	243,998
Potatoes .. .. cwts.	7,969,136	8,751,174	9,352,236	9,420,623
Butter .. .. ,,	1,637,939	1,795,413	2,045,606	2,319,802
Cheese .. .. ,,	1,651,088	1,965,949	1,789,168	1,773,503
Eggs .. .. .. great hundreds	6,257,892	6,529,036	6,388,838	6,228,437
Lard .. .. cwts.	592,944	908,187	838,897	929,616
Bacon .. .. ,,	2,395,223	3,466,565	3,996,922	4,370,860
Hams .. .. ,,	423,869	797,336	906,121	938,269
Salt Beef .. .. ,,	208,364	219,445	242,864	289,422
Salt Pork .. .. ,,	295,524	369,500	400,591	384,057
Clover Seeds .. .. .. ,,	358,056	305,049	345,206	271,609
Flax-seed and Linseed .. qrs.	1,706,796	1,990,529	1,665,333	1,712,576
Rape .. .. ,,	539,263	641,261	365,340	400,694
Sheep and Lambs' Wool .. lbs.	405,949,161	395,461,286	411,106,627	460,337,412

TABLE XV.—QUANTITY and VALUE of MEAT IMPORTED in the 6 YEARS, 1875–80.

QUANTITIES.

	1875.	1876.	1877.	1878.	1879.	1880.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Beef, Salted or Fresh ..	215,581	413,351	678,505	723,558	806,462	1,008,089
Meat, ,, ,, ..	144,954	92,556	130,178	145,493	151,505	148,788
Total	360,535	505,907	808,683	869,051	957,967	1,156,877
Meat, Preserved otherwise than by salting	171,373	283,066	469,003	438,903	566,758	655,600
Total Meat ..	531,908	788,973	1,277,686	1,307,954	1,524,725	1,812,477

VALUES.

	1875.	1876.	1877.	1878.	1879.	1880.
	£.	£.	£.	£.	£.	£.
Beef, Salted or Fresh ..	454,337	943,580	1,686,392	1,753,066	1,919,922	2,399,324
Meat, ,, ,, ..	419,019	281,830	388,933	426,864	436,317	428,285
Total	873,356	1,225,410	2,075,325	2,179,930	2,356,239	2,827,609
Meat, preserved otherwise than by salting	592,196	887,035	1,434,234	1,313,541	1,688,321	1,903,036
Total Meat ..	1,465,552	2,112,445	3,509,559	3,493,471	4,044,560	4,730,645

The quantity of meat imported in 1878 was 1,307,954 cwts., against 1,277,686 in the previous year; in 1879 the quantity was 1,524,725 cwts., being an increase over that of the previous year of 216,771 cwts.; in 1880 the quantity had still further increased to 1,812,477 cwts.

The average price of beef per lb. by the carcass at the Metropolitan Meat Market was $5\frac{5}{8}d.$ in 1879; in 1878 it was $6\frac{2}{8}d.$, showing a reduction in 1879 of 10 per cent. The average price of mutton per lb. was $6\frac{5}{8}d.$ in 1879; in 1878 it was 7*d.*, showing a reduction in 1879 of 5 per cent.; in 1880 the average price of beef per lb. was $6\frac{1}{8}d.$, of mutton per lb. $6\frac{7}{8}d.$, showing an increase over the previous year of 9 per cent. and 4 per cent respectively.

The reduction in the price of beef and mutton since 1876 was equal to 8 and 8 per cent. respectively.

In 1880 there was an increase, compared with the previous year, in the number of oxen, bulls, and cows of 142,230, and a decrease in swine and hogs of 1,237; there was a decrease also in the number of sheep and calves of 3,878 and 173 respectively.

STATISTICS OF DAIRY PRODUCE.

The following remarks relating to Butter and Cheese are extracted from 'The Grocer':—

Cork Butter Market.—Unlike its predecessor, the year 1880 was rather a monotonous one in the Cork market. It was not marked by any of those spasmodic fluctuations in prices which rendered the previous season a very memorable one. In 1879 prices fell from the end of April till they touched 76*s.*, 66*s.*, 61*s.* for firsts, seconds, and thirds, on August 22nd. Last season (1880) the downward course of prices in the Cork market was arrested on May 19th, when quotations for firsts, seconds, and thirds were 102*s.*, 95*s.*, 92*s.*, or about an average of 30*s.* per cwt. over lowest prices of previous year. This early change in the tendency of prices was caused by the prospect of dry weather, and by its beginning to be recognised that the usual number of milking cattle were not in the country. The surmises in both cases proved correct. The rain was conspicuous by its absence, and the Irish Registrar-General's report soon proved to what an extent the milking stock of the country had been reduced by the severe distress prevailing amongst the farming classes. On July 10th, Cork prices were 111*s.*,

104*s*., 98*s*.; prices were never so low again for the year, at least so far as firsts and seconds are concerned, nor did thirds return to 98*s*. till November 27th. The mild butters on July 10th were 117*s*., 108*s*., 105*s*. Prices advanced steadily from July 12th, and on the day they touched their lowest in previous season (August 22nd) they had advanced 19*s*., 20*s*., 14*s*. for ordinary firsts, seconds, and thirds, and 27*s*., 24*s*., 15*s*. for superfines, fines, and milds over the quotations on July 10th. The change in prices having taken place, there was little else of importance to note till a reaction set in on October 28th, when prices were 140*s*., 127*s*., 114*s*. Between that and the end of November firsts and seconds receded to 130*s*., 113*s*., at which prices speculators put large quantities into store, and when supplies began to fail in December they ran up prices quickly.

Butter.—In the first week in January, Clonmel and Carlow butters were quoted 126*s*. to 136*s*., f.o.b. No further transactions in them were then reported until the second week in May, when a few small sales were made at 128*s*., f.o.b.; the third week in that month they were quoted 104*s*. to 112*s*., at the end of the month they were 110*s*. to 114*s*., early in June, 110*s*. to 118*s*., nominally about the same at the end of the month, and so continued until the middle of July; later in the month they were 114*s*. to 122*s*.; early in August, 116*s*, to 124*s*.; at the end of the month they varied from 124*s*. to 132*s*. In September, choice was nearly nominal at 124*s*. to 138*s*.; October, 126*s*. to 142*s*.; and remained about the same to the middle of December. Holders of choice qualities firm, but buyers operating very sparingly.

Foreign Butter.—Danish butter was offered the first fortnight in January at 140*s*. to 150*s*. The first week in February to the first week in March, 140*s*. to 160*s*. The first week in May, when the new make was coming forward more freely, 135*s*. to 145*s*. From the end of May to the first week in June, 116*s*. to 120*s*. The first week in July, 110*s*. to 114*s*.; prices then advanced to the third week in August. At the close of September they were 140*s*. to 148*s*., and from the third week in October to the third week in November the variation was slight. From the end of the month to the last week in December, 150*s*. to 160*s*. Normandys began the year with firsts at 120*s*. to 130*s*. In the beginning of February they were 130*s*. to 150*s*. Throughout the greater part of March, firsts were 140*s*. to 150*s*., and in the first week in April 140*s*. to 154*s*.; afterwards 146*s*. to 154*s*.; the tendency was then downwards. By the third week in May, the new seasons make was becoming plentiful, and the last week in May, prices fell to 112*s*. to 116*s*. Early in July prices reached the lowest for the

season, firsts being quoted at 102*s.* to 103*s.* September began with firsts at 118*s.* to 126*s.* Early in November, firsts were 138*s.* to 146*s.*; the next three weeks, 136*s.* to 142*s.*; then to the first week in December, 135*s.* to 140*s.*

Dutch Butter.—The weather from the early part of January to the beginning of February was severe. There are frequently sudden fluctuations in this article. "Dutch butter" prices, the first fortnight, were 128*s.* to 130*s.*, the third week, 130*s.* to 140*s.*, and at the end of the month, 140*s.* to 148*s.*; the first week in February, 130*s.* to 136*s.*; the second week, 136*s.* to 140*s.*; then to the first week in March, 130*s.* to 136*s.*; the next fortnight, 140*s.* to 150*s.*; the last week, 134*s.* to 140*s.* The first fortnight in April, with small supplies, one of the sudden fluctuations so common in this market took place, the prices then being 144*s.* to 154*s.*; the third week, 120*s.* to 134*s.*; at the end of the month, 124*s.* to 134*s.* May began with prices 125*s.* to 134*s.*; the next week, 112*s.* to 120*s.*; then to the end of the month, 96*s.* to 104*s.*; the first week in June, 96*s.* to 112*s.*; the second week, 106*s.* to 114*s.* (the wide differences arising from the quality of the parcels consigned for sale being very inferior to those selected for and shipped direct to the trade); the third week, 94*s.* to 106*s.*; the last week in the month, 94*s.* to 108*s.* July began with the prices 92*s.* to 104*s.*; the second week, 104*s.* to 116*s.*; next week, 118*s.* to 122*s.*; the last week, 112*s.* to 118*s.* Early in August prices were 116*s.* to 124*s.*; then 112*s.* to 128*s.*; the last week in the month and the first week in September, 116*s.* to 128*s.*; next week they suddenly advanced to 126*s.* to 140*s.*; the third week, 130*s.* to 144*s.*; the end of the month, 130*s.* to 140*s.*; early in October, 128*s.* to 136*s.*; the next fortnight, 132*s.* to 144*s.*; the two following weeks, 136*s.* to 148*s.*; early in November, 132*s.* to 142*s.*; the next week, 132*s.* to 140*s.*; then from the last week of that month to the first week in December, 125*s.* to 140*s.*; the next two weeks, 130*s.* to 140*s.* The weather throughout this month was very mild.

American Butter.—The first fortnight in January prices varied according to quality, from 90*s.* for common kinds to 130*s.* for best; next week they were 90*s.* to 135*s.*; at the end of the month, 70*s.* to 140*s.*; the next four weeks, 70*s.* to 135*s.*; then the first two weeks in March, 70*s.* to 140*s.*; the third week, 70*s.* to 145*s.*; from the end of the month to the beginning of April they were 90*s.* to 140*s.*; the following week, 90*s.* to 150*s.*; the third week, 135*s.* to 145*s.* Then from the last week in April to the first week in June the quotations were 95*s.* to 135*s.*; the second week in June, market prices were 75*s.* to 106*s.*; third week, 74*s.* to 116*s.*; the end of the month, 80*s.* to 112*s.*; the first fortnight in July, 70*s.* to 114*s.*; next

week, 75*s.* to 114*s.*; then to the beginning of August, 80*s.* to 116*s.*; from this time to the end of the month, 80*s.* to 116*s.*; early in September, 85*s.* to 126*s.*; the next week, 95*s.* to 136*s.*; at the end of the month, 100*s.* to 130*s.*; at the opening of October, 90*s.* to 130*s.*; second week, 95*s.* to 140*s.*; the next fortnight, 100*s.* to 144*s.*; from the first to the third week in November, 100*s.* to 142*s.*; then from the last week in the month to the third week in December, from about 90*s.* to 134*s.*

Cheese.—The year commenced with the market firm for both fine English and American, and so continued until the new season's make came to hand. The fluctuations, however, in fine English were so small that they may be said to have averaged from 76*s.* to 86*s.* the greater part of the year. American best the first fortnight in January, 66*s.* to 70*s.*; lower qualities, 58*s.* to 62*s.* The next three weeks, 70*s.* to 74*s.*; second rates, 62*s.* to 68*s.* Throughout February, best, 72*s.* to 74*s.*; lower qualities, 66*s.* to 70*s.* From the beginning of March to the first week in April, best, 72*s.* to 75*s.*; lower qualities, 66*s.* to 70*s.* The second and third weeks in April, best, 74*s.* to 76*s.*; lower qualities, 68*s.* to 72*s.* Throughout May, best, 74*s.* to 78*s.*; lower qualities, 68*s.* to 72*s.* The last season's make finished, the middle of June, at 72*s.* to 74*s.* For a few new that arrived about the third week in May prices were 66*s.* to 72*s.*; next week, 65*s.* to 70*s.*; then to the middle of June, 65*s.* to 68*s.* The last week in June, best, 70*s.* to 74*s.*; then, with more liberal supplies, best, 56*s.* to 60*s.* To the middle of July, prices varied from 52*s.* to 58*s.* The first week in August, best, 54*s.* to 56*s.*; lower qualities, 46*s.* to 52*s.*; next week, best, 56*s.* to 68*s.*; lower qualities, 48*s.* to 52*s.*; second week, best, 60*s.* to 63*s.*; third week, 59*s.* to 62*s.*; last week, 64*s.* to 68*s.* Lower qualities during that time, 54*s.* to 58*s.*, then 46*s.* to 56*s.*; last week, 52*s.* to 64*s.* Best, the first week in September, were 66*s.* to 70*s.*; next week, 66*s.* to 69*s.*; then 66*s.* to 68*s.*; then 66*s.* to 67*s.*; then, the first week in October, 66*s.* to 69*s.*; then, from the second week this month to the second week in November, 68*s.* to 70*s.*; then, from the third week in November to the end of the year, best scarcely varied from 68*s.* to 72*s.* Lower qualities, from the first week in September to the third week in October, 56*s.* to 64*s.*; then 56*s.* to 67*s.* to the middle of November; then 58*s.* to 67*s.* to the end of the year, the market closing steady at these prices.

The following Quotations, &c., are extracted from 'The Grocer.'

TABLE XVI.—AVERAGE and CURRENT PRICES of BUTTER and CHEESE on 1st SATURDAY in JANUARY of each YEAR, from the latest actual MARKET SALES.

	Average Annual Price in the 5 years, 1870–74.	Average Annual Price in the 5 years, 1875–79.	Current Price, 1st January, 1880.	Current Price, 1st January, 1881.
	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.	Per cwt. s. s.
Butter:				
Carlow, finest, F.O.B	126 to 136	131 to 144	126 to 140	120 to 140
,, Landed ..	124 ,, 138	138 ,, 148		
Cork, 1sts..	138 ,, 143	143 ,, 148	145 ,, ..	141 ,, ..
,, 2nds	129 ,, 135	133 ,, 137	143 ,, ..	132 ,, 135
,, 3rds, new ..	111 ,, 116	108 ,, 109	115 ,, ..	105 ,, ..
,, 4ths	98 ,, 98	90 ,, 91	96 ,, ..	78 ,, ..
Limerick..	117 ,, 121	124 ,, 129		
Foreign:				
Friesland..	113 ,, 130	132 ,, 137	128 ,, 134	120 ,, 130
Jersey, &c.	79 ,, 129	94 ,, 134	125 ,, 136	110 ,, 125
Kiel	111 ,, 145	135 ,, 164	.. ..	.. ..
Normandy	93 ,, 150	92 ,, 151	120 ,, 146	108 ,, 140
American	82 ,, 115	81 ,, 121	90 ,, 135	95 ,, 125
Bosch	.. ..	.. ..	65 ,, 95	65 ,, 84
Cheese:				
English Cheddar, fine, new	76 ,, 90	72 ,, 90	72 ,, 86	76 ,, 90
,, good, new	74 ,, 93	.. ..	.. ..	.. ..
Red Somerset Loaf..	68 ,, 81	77 ,, 87	74 ,, ..	76 ,, 82
White or yellow Cheddar Loaf ..	72 ,, 81	78 ,, 87	.. ..	.. ..
Scotch Cheddar ..	67 ,, 77	164 ,, 189	.. ..	.. ..
Cheshire, new.. ..	76 ,, 87	78 ,, 86	64 ,, 86	74 .. 88
,, good ditto	58 ,, 70	53 ,, 71	.. ..	.. ..
Wiltshire, new ..	67 ,, 78	70 ,, 79	62 ,, 76	70 ,, 80
,, good ditto	57 ,, 64	60 ,, 68	.. ..	.. ..
North Wilts Loaf, new	66 ,, 80	72 ,, 81	.. ..	72 ,, 82
Derby ,, ,,	65 ,, 83	74 ,, 64	70 ,, 74	76 ,, 84
Foreign:				
American, fine ..	68 ,, 73	63 ,, 67	64 ,, 68	68 ,, 72
,, good ..	54 ,, 65	41 ,, 59	56 ,, 60	56 ,, 66
Gouda	49 ,, 64	52 ,, 61	56 ,, 62	60 ,, 66
Edam, new	53 ,, 68	56 ,, 65	56 ,, 64	62 ,, 68
Gruyère, new	.. ..	76 ,, 85	71 ,, 78	62 ,, 82

TABLE XVII.—QUANTITY and VALUE of BUTTER IMPORTED from DENMARK, 1865–79.

Years.	Quantities.	Computed Real Value.	Years.	Quantities.	Computed Real Value.
	Cwts.	£.		Cwts.	£.
1865	65,555	362,440	1873	201,558	1,203,459
1866	67,305	319,528	1874	226,053	1,363,433
1867	80,589	422,479	1875	206,171	1,275,870
1868	79,437	471,262	1876	205,195	1,311,234
1869	103,613	574,981	1877	210,322	1,347,791
1870	127,013	767,190	1878	242,427	1,517,467
1871	140,851	803,226	1879	281,740	1,673,452
1872	173,574	1,009,322			

TABLE XVIII. — QUANTITY and VALUE of BUTTER Imported from the UNITED STATES, BELGIUM, FRANCE and HOLLAND; and of CHEESE Imported from the UNITED STATES and HOLLAND, 1865–79.

Years.	UNITED STATES.			
	Butter.		Cheese.	
	Quantities.	Computed Real Value.	Quantities.	Computed Real Value.
	Cwts.	£.	Cwts.	£.
1865 ..	83,216	437,703	442,913	1,296,204
1866 ..	16,059	77,754	415,726	1,386,447
1867 ..	39,035	113,290	526,740	1,470,017
1868 ..	7,117	37,279	489,117	1,439,380
1869 ..	17,203	84,603	487,870	1,612,325
1870 ..	16,915	80,928	555,385	1,861,263
1871 ..	83,775	394,359	731,326	2,014,805
1872 ..	45,765	199,679	598,198	1,701,435
1873 ..	43,406	199,639	790,238	2,353,181
1874 ..	36,307	188,769	849,933	2,589,776
1875 ..	40,331	205,900	958,978	2,786,027
1876 ..	118,131	593,122	936,203	2,564,977
1877 ..	188,491	920,561	1,082,844	3,129,829
1878 ..	219,794	998,766	1,345,745	3,306,612
1879 ..	301,054	1,243,075	1,214,959	2,467,651

Years.	BELGIUM.		FRANCE.	
	Butter.		Butter.	
	Cwts.	£.	Cwts.	£.
1865 ..	70,619	433,179	353,115	1,867,085
1866 ..	76,667	426,712	452,196	2,276,493
1867 ..	80,754	470,464	450,693	2,265,147
1868 ..	70,456	405,987	393,578	2,156,824
1869 ..	85,789	481,609	407,432	2,231,450
1870 ..	84,408	516,643	289,692	1,672,899
1871 ..	94,539	523,460	304,683	1,636,006
1872 ..	74,191	409,555	355,089	1,916,795
1873 ..	76,610	439,501	446,550	2,409,861
1874 ..	76,723	465,517	713,251	3,944,233
1875 ..	79,950	499,028	567,560	3,387,219
1876 ..	65,309	419,209	622,488	3,732,405
1877 ..	58,200	378,435	606,762	3,654,488
1878 ..	80,073	499,889	555,272	3,179,326
1879 ..	63,032	391,166	438,725	2,264,591

Years.	HOLLAND.			
	Butter.		Cheese.	
	Cwts.	£.	Cwts.	£.
1865 ..	345,026	1,886,486	386,962	1,100,037
1866 ..	383,225	1,979,070	426,559	1,317,231
1867 ..	326,217	1,733,459	332,628	961,245
1868 ..	343,322	1,992,414	329,565	959,547
1869 ..	415,176	2,253,420	426,913	1,262,101
1870 ..	406,795	2,388,459	422,553	1,204,830
1871 ..	390,616	1,986,708	348,148	954,236
1872 ..	269,091	1,358,579	329,535	942,537
1873 ..	279,004	1,453,875	336,654	1,013,233
1874 ..	351,605	1,877,755	398,888	1,164,921
1875 ..	357,106	1,917,910	370,123	1,078,594
1876 ..	402,984	2,252,909	330,435	949,413
1877 ..	372,134	2,084,686	341,980	984,855
1878 ..	460,601	2,494,903	355,159	1,018,669
1879 ..	655,377	3,331,149	275,039	743,107

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

I.—*Report of Experiments on the Development of the Liver-Fluke* (Fasciola hepatica). By A. P. THOMAS, B.A., Demonstrator of Anatomy, University Museum, Oxford.

1. *The Egg and Embryo of the Fluke.*—The eggs of the liver-fluke occur in very large numbers in the contents of the bile-ducts and gall-bladder of the infected animal. They give a dark-brown colour and sandy appearance to the bile, and in some of the smaller terminal ducts often form a stiff brown mass completely plugging up the lumen. They pass with the bile into the intestines, and may be found abundantly in the droppings of rotten sheep.

The egg is an oval body with a smooth, transparent, yellowish-brown, chitinous shell. The average size may be said to be 0·13 mm. in length by 0·08 mm. in breadth, but the dimensions vary greatly, the length from 0·105 mm. to 0·145 mm., and the breadth from 0·066 mm. to 0·09 mm. The anterior end is a little more rounded than the posterior, and has a line running around it, which marks off a circular segment forming a cap or operculum 0·028 mm. in diameter. The opposite end is frequently a little thicker and slightly roughened.

The number of eggs produced by a single fluke is exceedingly large, and its fecundity has been under-rated. Leuckart has estimated that the oviduct can contain as many as 45,000 eggs. In one case I obtained 7,400,000 eggs from the gall-bladder of a sheep suffering from the rot, and as the liver contained about 200 flukes, this gives an average of 37,000 eggs to each fluke. And these eggs were found in the gall-bladder alone; the liver must have contained at least as many more, and eggs had been passed copiously by the sheep for some months past. The number of eggs produced by a single fluke may be safely estimated at several hundred thousands.

When the egg has just been laid, the contents are formed by a number of spherical masses of a clear substance containing many granules. These spheres consist of secondary yolk, and are physiologically equivalent to the white of the fowl's egg; they are often slightly polygonal from mutual pressure, and between them are a few bright yolk-granules. Surrounded by the secondary yolk-spheres, and near the anterior end of the egg, is a heap of pale nucleated cells with indistinct outlines, which represent the future embryo, and have been formed by the cleavage of the primitive ovum in its descent through the oviduct. The development of the embryo does not proceed beyond this stage whilst within the bile-ducts of the sheep; it can only take place out of the body of the bearer of the adult fluke, and at a lower temperature. Eggs kept in water in an incubator at the temperature of the mammalian body do not make any progress, whilst other eggs kept at a lower temperature complete their development in a few weeks. The necessary conditions for development are moisture and a certain moderate degree of warmth; light I have found to exert no influence. Eggs taken from the gall-bladder and placed directly with water into an opaque vessel, develop as soon as similar eggs exposed to the light, but otherwise kept under the same conditions. A temperature of about 23° C. to 26° C. is most favourable, and with this degree of warmth the embryo is formed in about two or three weeks. At a lower temperature development takes place much more slowly, and with an average warmth of 16° C. occupies two or three months. During the winter no progress is made.

All the eggs under the same conditions, however, do not produce embryos in the same time; a certain number are hatched out on every successive day for some weeks or even months, and at the end of this time some of the eggs may remain in the same condition as when just laid. No explanation can be discovered in the eggs themselves of the very variable time required for the development of the embryo, but the fact is of much practical importance, for eggs scattered over any damp ground will render it more or less dangerous for a longer period than one year.

The body of the embryo is formed by the growth of the inner cellular mass at the expense of the secondary yolk-spheres which surround it. The outlines of the yolk-spheres become more distinct and their contents less granular, whilst the granules are often aggregated at one side of the sphere; they become more fluid, and their remains gradually coalesce and lie on one side of the egg. The body of the embryo elongates and comes to occupy the whole length of the egg. A papilla appears at the anterior end, and behind this two annular furrows, between which a quantity of dark-brown pigment is pro-

duced, forming the eye-spot. Wave-like peristaltic contractions pass along the body from the anterior to the opposite end. In the last stage, when the embryo is nearly ready to emerge from the shell, it lies slightly curved upon itself at one side of the egg, the remainder of the space on the opposite side being occupied by the fluid remains of the coalesced yolk-spheres. At the anterior end, just beneath the operculum, is a quantity of viscid mucus, which forms a sort of lining or cushion to this end of the egg. Around the body of the embryo may be distinguished a bright border, which is formed by its covering of cilia; these cilia, however, can only in exceptional cases be seen in motion before the animal quits the egg.

The embryo is now ready to come forth; its movements become more marked, and at length a more vigorous extension of the body causes the operculum to fly open as if moved by a spring. The cap of mucus pours out, the embryo thrusts the fore part of its body out of the shell, the cilia begin to move instantly the water touches them, and the animal after a short struggle succeeds in drawing the whole of its body through the narrow opening of the shell, and glides away with ease and rapidity through the water. Although light has no influence in accelerating development, the embryo itself is sensitive to it. I have repeatedly observed that on removing a vessel of eggs from the darkened incubator in which they were being hatched, only two or three embryos could be seen, but that after it had stood in a window for twenty minutes the water was quite nebulous from their presence.

The form of the embryo is an elongated cone with rounded apex, its average length 0·125 mm., its breadth at the anterior end 0·027 mm. The broader end or base of the cone is directed forwards, and in the centre of this is a short retractile head-papilla. The embryo is exceedingly active, and, with head-papilla drawn in, swims restlessly through the water. Sometimes it goes directly forwards and then rotates on its longitudinal axis; at others, by curving its body, it sweeps round in circles, or, curving itself still more strongly, spins round and round without moving from the spot. If it comes in contact with any object, it stops for a moment as if trying to discover its nature. The whole of the surface, with the exception of the head-papilla, is covered by long cilia (0·012 mm. in length), which are borne by a cuticle composed of five transverse rings of flattened cuticular cells about 0·03 mm. long, each with a small nucleus 0·003 mm. in diameter. The cilia are of the same length over the whole of the cuticle, but on the cells of the anterior ring they are more numerous and thus more conspicuous. This first row is composed of four cells arranged round the

papilla, and these are thicker than the other cuticular cells, often forming ear-like projections at the side of the embryo and resembling epaulets. Beneath this cuticle the substance of the body is made up of delicate vesicular nucleated cells, which, whilst the animal is living, have very indistinct outlines. In some embryos the central cells appear to be arranged in more or less distinct rounded masses. A little way behind the first ring of cells is situated the eye-spot, which belongs to the deeper layer of the body. It does not resemble the sign of multiplication as has been described, but is really double, and is formed by two crescentic masses of dark pigment, placed with their convex sides turned towards each other, and in contact near the anterior horns. Beneath the cuticle, and especially just behind the eye-spots, are numerous yellowish, strongly refracting fat-granules. Just behind the head-papilla there is a globular portion of the body which has a somewhat different appearance from the rest of the parenchyma, and reacts differently with staining agents. This may possibly be the rudiment of a digestive tract, but it is only slightly differentiated as yet. Narrow passages may be indistinctly seen on either side of the embryo; these are the excretory vessels, which have been found in several other trematode embryos. Midway between the extremities of the body, and on the right and left of the middle line, are two funnel-shaped spaces provided with cilia in constant motion.

Under ordinary conditions the head-papilla of the embryo is truncated in front, and seems to have a slight depression in its centre; but when the embryo is engaged in boring, the depression disappears and the papilla becomes longer, conical, and distinctly pointed, and indeed often appears to be terminated with a short style. I have not been able to demonstrate the presence of any chitinous structure, but this pointed papilla would undoubtedly prove a very efficient boring-tool. The embryo may often be seen attempting to bore its way into the glass of the slide under the microscope; it spins round and round on its longitudinal axis, alternately drawing up its body and suddenly stretching it out at full length. I have observed one boring for more than half-an-hour at its own empty egg-shell, which happened to be on the same slide, and only giving up the attempt when it was too feeble to move away.

In water the average duration of the embryo's life is only about eight hours, though occasionally one may live over night. The motion then becomes gradually feebler, and at length ceases; the embryo assumes an oval or elliptical shape; the ciliated cuticular cells absorb water, and swell up into round vesicles, and the whole body disintegrates. In mucus the embryo will

live rather longer, and in a feebly alkaline solution of peptone I have been able to keep them alive for three days. The cilia were not lost, but their motion after the first day became very sluggish; the embryos increased a little in size, but no advance in organization took place, except perhaps that the cellular parenchyma became arranged into rather more definite spherical masses.

2. *Further Development of the Embryo.*—What is the ultimate fate of this embryo? and by what stages is it connected with the adult fluke as found in the bile-ducts of the sheep? Its instinct evidently prompts it to bore its way into some object, and its organization is so simple, and its resemblance to the embryos of other Distomidæ whose life-history has been made out is so close, that there is little reason for supposing its further development to depart from the ordinary type among the Distomidæ: that is, we should expect to find it make its way into some animal—most probably a mollusc—and then, losing its cilia, be metamorphosed into a brood-sac or sporosac, from which, in the first or later generation, larval cercarian forms will be produced by internal gemmation; and after a period of quiescence these cercariæ will, if they gain access to a suitable vertebrate host, give rise to adult sexual flukes. The embryos of *Distoma nodulosum* and *Distoma trigonocephalum* are very like that of *Fasciola hepatica*; the former gives rise to a sporocyst in *Bithynia tentaculata*, and the latter to a redia in certain species of *Paludina*.

This intermediate host will most probably be a mollusc, for very few instances are recorded of the occurrence of the sporosac form in any other than a molluscan host. There may indeed be more than one bearer for the brood-sac of *Fasciola*, for although some larval forms of trematodes are restricted to a single host, such as the *Leucochloridium paradoxum* of *Succinea amphibia*, others are less particular, and may be found in several different molluscs; thus the rediæ of *Cerc. echinata* occur in *Paludina vivipara*, *Limnæus stagnalis* and *Planorbis corneus*, and the sporocysts of *Cerc. armata* in the two last.

Assuming that there is an intermediate molluscan bearer, the question still remains, In what form does the fluke enter the sheep? and in what way? Does it enter with the food? or the drink? or by some other method? In the case of other Distomidæ the migration into the ultimate host is, so far as is known, always passive,* and the parasite is taken up with the food.

* Wagener ('Eingeweidewürmer,' p. 41) was unable to find the cysts of *Cercaria macrocerca*, which develops into *Distoma cygnoides* of the frog, and suggested originally that this *cercaria* may wander directly into the frog, but did not prove the point experimentally. Thiry, however, ('Zeitschrift für wissenschaftliche Zoologie,' vol. x. p. 276) has succeeded in finding the cysts of *Cerc. macrocerca* in all parts of small *Limnæi*.

The cercaria, when fully formed, makes its way out of the sporosac which has produced it, and encysts itself either in the same mollusc, or more frequently it passes out into the water, and after a short free life encysts itself in another snail of the same species, or it may be of a different species. But with all aquatic cercariæ an encysted stage seems to be necessary, and no instance is known of direct development of the cercaria into the mature form without the intervention of a period of quiescence. When *free* cercariæ have been given to the animals which form their natural abode in the adult state, these cercariæ have always failed to develop further.*

The sporosacs of Distomidæ have only been found in molluscs and fish, but the encysted larvæ are more widely distributed, and have been found not only in molluscs, but also in the aquatic larvæ of insects (*Perla*, *Ephemera*, &c.); in *Crustacea*, especially *Gammarus;* in *Hydrachna;* rarely in worms; in small fish, tadpoles, frogs and newts; that is, in animals which serve as food for other creatures. Some cercariæ encyst themselves on plants, or on the sides of the vessel which contains them; indeed, the instinct to encyst is so imperative at a certain moment of their lives, that it takes place wherever the cercariæ happen to be.

Judging from the analogy with other flukes, it is most probable that sheep pick up the young liver-flukes whilst in the encysted state with their food. It is not likely to be taken up with the water drunk by the sheep, for free cercariæ would perish. Moreover, rabbits are exceedingly liable to flukes—I have found as many as fifty in a single rabbit's liver—and sportsmen deny that they ever drink. It has been conjectured that the sheep takes up the fluke by eating the mollusc which harbours the larvæ. Sheep and many other animals are passionately fond of salt, and might possibly eat snails intentionally on account of their saline taste. Mr. C. Spence Bate, F.R.S., says that "as a rule, farmers encourage the snails, as they say that the sheep are fond of them." But other observers have come to the opposite opinion, and it would seem more probable that the molluscs, if eaten at all, are swallowed accidentally, being mixed with the food. In this case of course any large mollusc could not be taken up.

Or, infection may be produced in another way. The cercaria of *Fasciola* may encyst itself at the moist roots of plants, and then be taken up when the sheep is grazing. In examining

* In the case of *Distoma nodulosum*, if *Acerina cernua* (the pope), which is one of its ultimate hosts, be fed with cysts, the included distomes develop to the adult condition in the intestine, and produce eggs; but if fed with free cercariæ these encyst themselves on the outer surface of the intestine, and do not come to perfection until the host itself falls a prey to some larger species of fish, as the perch. In this instance the same animal may serve either as intermediate or ultimate host.—O. von Linstow, *Archiv für Naturgeschichte*, 1873, p. 1.

the contents of the paunch of a recently infected lamb, I found numerous portions of the roots of grasses. This view has much to recommend it, and in accordance with it is the opinion of farmers, that the fluke is especially taken up when the sheep graze closely, and that the better the biter is, the worse are the chances of escape. We know one form of cercaria inhabiting the common black slug, which is left behind in the mucous trail of this animal; but this will be discussed more fully below.

The following letter has been sent to Professor Rolleston, with the request that it may be published.

"Dr. Gwyn Jeffreys, F.R.S., who has long studied snails and slugs, is of opinion that sheep do not willingly or knowingly eat them, and that the germs or embryos of the fluke are not introduced in that way into the sheep's liver. He believes that this parasite finds its way into the sheep's body through the feet, or the wool when the sheep lies down. He therefore recommends that where the sheep are kept on marshy or moist pastures they ought to be taken in at night, and for the early part of the morning, when the flukes and their nurses (certain snails and slugs) are most numerous and active. Upland and dry meadows, however, appear to suit sheep better than marshy or moist pastures."

Experiments have been made to determine which mollusc or molluscs act as host to the conjectured sporosac form of *Fasciola hepatica*; and here the number of molluscs which need concern us was indicated by their geographical distribution and by that of the fluke itself. As the fluke is only met with on wet ground, we may neglect such snails as are confined to high and dry ground. Willemoes-Suhm had pointed out * that in the Faroe Islands, where sheep suffer severely from the fluke, the molluscs are restricted to eight species, viz., *Arion ater*, *A. cinctus*, *Limax agrestis*, *L. marginatus*, *Vitrina pellucida*, *Hyalina alliaria*, *Limnæus pereger*, and *L. truncatulus*. Of these, *Limax agrestis*, our common grey slug, was by far the commonest and most injurious, and he suggested that this slug might act as intermediate host. In a letter to the 'Times,' of April 14, 1880, Professor Rolleston gave reasons for suspecting the black slug, *Arion ater*. He has recently ascertained that the liver-fluke does actually occur in the Shetland Islands, where the pulmonate molluscs are, according to Forbes,† restricted to the five species, *Arion ater*, *Limax cinereus*, *Vitrina pellucida*, *Helix alliaria*, and *Limnæus pereger*. The only one of these which is at all plentiful is *Arion ater*. Slugs have been received from the Shetland Islands as specimens of the only two kinds

* 'Zeitschrift für wissenschaftliche Zoologie,' 1873, vol. xxiii. p. 339.
† 'British Association Report,' 1859, p. 127.

known there, and these have been identified as *A. ater* and *Limax cinereus.* The last-mentioned slug does not occur in the Faroe Islands, but the other four species are common to the two places, and one of them must be capable of acting as intermediate host to *Fasciola.* The question of distribution is further discussed in the following paper, for which I am indebted to Professor Rolleston. It appeared in the 'Zoologischer Anzeiger' of Aug. 9, 1880.

Note on the Geographical Distribution of Limax agrestis, Arion hortensis, *and* Fasciola hepatica. By GEORGE ROLLESTON, F.R.S., Linacre Professor of Anatomy and Physiology, Oxford.

THAT some not inconsiderable confusion exists as to the question of the existence of *Arion ater* and *Limax agrestis* in Greenland, will be seen from the following quotation, to be found as hereinafter specified :—

'A Manual of the Natural History, Geology, and Physics of Greenland, together with Instructions for the Use of the Arctic Expedition.' 1875. London.

(*P.* 124.) "*Mollusca Groenlandica :*

Classis i. ANDROGYNA, Mörch.
Ordo i. GEOPHILA, Fér.
*1. *Arion fuscus*, Müll. Probably introduced. *L. agrestis*, L., according to Wormskiold.

The species marked with an * are doubtful inhabitants of Greenland."

Prefixed to the list whence the above passage is taken is a note to the effect that the list is the "Prodromus Faunæ Molluscorum Groenlandiæ (in Rink's 'Grönland,' &c., 1857, pp. 75–100). By Dr. O. A. L. Mörch. Revised and augmented by Dr. O. A. L. Mörch, University Museum, Copenhagen. April, 1875."

On referring, however, to the Prodromus itself, as published in Danish in 1857, I find the entry which concerns us stands simply thus :—

"*Mollusca Grönlandica :*

Order i. GEOPHILA.
Gen. i. *Limax*, L.
*1. *L. agrestis*, L. (ifolge Wormskjold).

*Betigner at Artens Forekomst paa Grönland ikke er sikker."

That is to say, that the line in the entry given in the Manual of 1875—"*Arion fuscus*, Müll. Probably introduced"—is altogether something fresh and new; whilst the asterisk, denoting that the animal so marked is possibly not indigenous, was

removed from the Limax agrestis, and prefixed to the curious name "Arion fuscus, Müll."

It is difficult to understand how the late Dr. O. A. L. Mörch can have come, in 1875, to alter his previous entry in this manner. For the name "Arion" was unknown to Müller, the author of the 'Historia Vermium,' having been introduced into malacology by Férussac, as he himself tells us;* and as regards the animal itself, on the supposition that Dr. Mörch, by his entry "*Arion fuscus*, Müll.," intended to have written "*Limax fuscus*, Müll.;" and knowing that this Limax, so called by Müller, was really an *Arion* (*hortensis*), and not a slug with a posteriorly placed respiratory inlet and a continuous shell, it is still more difficult to see how he could have added the word *L. agrestis*, L., apparently as a synonym. For in the thirteenth edition of the 'Systema Naturæ,' tom. i. pars vi. pp. 3101–3102, the (true) "*Limax agrestis*" is distinguished from the "*Limax fuscus*" (=*Arion hortensis* hodie) of "Müller, 'Hist. Verm.' ii. p. ii. n. 209."

On referring to Dr. O. A. L. Mörch's "Faunula Molluscorum Islandiæ," communicated on the 13th April of 1866, and published in 1868, in Danish, in the 'Vidensk. Medd. fra den naturhist. Forening i. Kbvn,' pp. 185–227, I find at p. 196, 3, that "*Limax agrestis*, L." stands with a ? after its name, even though there can be no doubt from references to Olafsen, several of which are, in fact, given by Mörch, that *a* grey slug, as well as the black slug, *Arion ater*, exists in Iceland. And a suggestion at the end of the entry, to the effect that the specimens may possibly belong to the species *Limax tenellus*, appears to explain the presence at the beginning of it of a ? after the words *Limax agrestis*.

Perhaps, therefore, the true explanation of the entry in the Manual of 1875 is as follows. In the interval between 1857 and 1875 a black slug may have been proved to Dr. Mörch's satisfaction to have been found in Greenland, and he may have identified it as the *Arion fuscus* of Moquin-Tandon, which is the same as the *Arion hortensis* of Férussac, *and* as the *Limax fuscus* of Müller and Linnæus; and he may, by a very slight slip, have entered it as "*Arion fuscus*, Müll.," instead of "*Arion fuscus*, Moquin-Tandon," or "*Limax fuscus*, Müll." To his addition "Probably introduced," some objection might be taken on the ground that there is no very strong *a priori* reason why an Arion should not exist in Greenland, considering that it exists in Iceland, the land shells of which Mörch himself†

* 'Hist. Nat. des Mollusques,' ii. 1820–1851, pp. 23 and 54.
† See Manual, p. 135.

allows are nearly allied to those of Greenland, and is not only an acknowledged member of the circumpolar fauna,* but the most abundant of all slugs in Finmark and Lapland. It is curious—and not only curious, but in view of the question of the distribution of *Fasciola hepatica* also important—to note what follows. In 1875 Dr. Mörch appears, after thus adding *Arion hortensis* to his former list of Greenland mollusca, to have been content to leave the entry of "*Limax agrestis*, L., according to Wormskiold," untouched, though in smaller type, feeling, probably, that as the entry of the animal was overtly made only on the authority of Wormskiold, he was in no way pledged either to holding that it was *Limax agrestis*, and not *Limax tenellus*, which existed in Greenland, or, indeed, to holding that any Limax whatever existed there. What completes my case is the fact that in 1877, when preparing a list of the Greenland mollusca for the English translation of Dr. Rink's 'Grönland, of 1857, Dr. Mörch omits all mention of *Limax agrestis* altogether, and his entry runs as follows (p. 436):—

"Class i. ANDROGYNA.
Order i. GEOPHILA, Fér.
1. *Arion fuscus*. Probably introduced."

If we follow Dr. Mörch, therefore, we shall strike *Limax agrestis* out of the list of Greenland mollusca, and hold that *Arion hortensis*, which exceeds it in number in other circumpolar regions, has in Greenland displaced, or at any rate replaced, it altogether.

If, however, *Limax agrestis*, notwithstanding the advantage which its coloration might be supposed to have been likely to give it, is beaten in the struggle for existence in circumpolar districts by *Arion hortensis*, of about the same size, but of such different colour in other districts, if not in the North,† as not

---

* Middendorff, indeed, in his 'Sibirische Reise,' ii. 1851, p. 419, omits the name of this small slug from his list of Circumpolar Freshwater and Land Molluscs, but five pages farther on, *l.c.*, says in a note, "Vielleicht ist *Limax* (Arion) *sub-fuscus*, Drap. (Drap. 'Moll.' p. 125, pl. ix. 8; *Limax fasciatus*, Nillsen, 'Hist. Moll. Suec.' 1822, p. 3) eine circumpolare Art dieses Geschlechtes;" and he proceeds to note its discovery by himself within the polar circle in Finland, feeding on sphagnum, as also in Lapland, feeding on fungi, up to 69° N. Lat. Schrenk ('Reise in Amurlande,' 1859-1867, ii. p. 692), whilst identifying the *Limax sub-fuscus* of Draparnaud with the *Arion hortensis* of Férussac, and so with the *Limax fuscus* of Müller and Linnæus, confirms the view as to its circumpolar character, and uses it as an argument for its being indigenous in America.

† Even in England, where the *Arion hortensis* is often of a "deep blue-black," and is, I suspect, the "Black Jack" of agriculturists; it is not rarely "yellowish, sometimes gray or greenish-gray."—(Lovell Reeve's *British Land and Freshwater Molluscs*, p. 11). In Amoorland it is "graugelblich," with three stripes, one dorsal and two lateral narrower ones; whilst its rival the *Limax agrestis* is described as "hell-bräunlich- oder bläulich-grau."—See Schrenk, *l.c.*

only to have been called *fuscus* and *sub-fuscus*, but even to have been confounded with the true *Arion ater* (from which, indeed, it is mainly distinguished by its more mesially placed respiratory orifice and its small size)—it surpasses *Arion hortensis** in more southern latitudes.

Middendorff indeed expressly says, *l.c.*: "In Siberien traf ich diesen *Limax* (*Arion hortensis*) nicht, sondern nur einen einzigen kleinen *Limax* in *Starowoj* Gebirge, welcher dem *Limax agrestis*, L. recht ähnlich sehe." But this absence from Siberia, to which F. Schmidt's silence as to its presence bears some testimony, may be paralleled by the similar absence of *Paludina vivipara* (Middendorff, *l.c.*, p. 426) and of crayfishes from the Siberian river basins,† and, as in those two cases, when compared with the facts of a distribution elsewhere does not disprove a circumpolar character.

Gerstfeldt, 'Mém. Sav. Etrang. St. Pétersbourg,' 1859, 515 (11), refers to some few, small, ill-preserved specimens, "einige wenige kleine und schlecht erhaltene Exemplare" of slugs from Irkutsk and Wilni and from the Amur, and speaks of them under the name *Arion ater*. Their small size may justify us in supposing them to have been *Arion hortensis*; and the bad state of preservation in which they were, and which makes Gerstfeldt himself speak doubtfully of his identification, p. 535 (31), makes this note of their presence less authoritative than it otherwise would have been, and has caused Schrenk to suggest that they were in reality specimens of *Limax agrestis*.

An illustration of the paucity and rarity of *Limax agrestis* in circumpolar regions is furnished by the entry made by Frederich Schmidt in his list of Animals from the Region of the Lower Yenisei, 'Mém. Acad. St. Pétersbourg,' 1872, p. 48, as to this eminently social mollusc: "In einem faulen Treibholzstamm auf den grossen Brjochow Insel (70° N. Br.) *in einem Exemplar* gefunden." But, *per contra*, in Amoorland, Schrenk tells us, *l.c.*, that *Limax agrestis* outnumbers *Arion hortensis*, just as *Arion hortensis* outnumbers *Limax agrestis* in Sweden, Finland, and Lapland, and that while *Limax agrestis* spreads into Spain, Portugal, Italy, Algeria, and the southern slopes of the Caucasus, *Arion hortensis* reaches no farther south than the southern slopes of the Pyrenees and Alps.

In a letter published in the 'Times' of April 14, 1880, and republished with certain omissions in the 'Zoologischer Anzeiger' of May 24, p. 258–260, I suggested that *Arion ater* may be the "*Zwischenwirth*," or one "*Zwischenwirth*," to *Fasciola*

* See Schrenk, 'Amurlande,' ii. 690–693, 1869. Middendorff, 'Sibirische Reise,' ii. p. 424, 1851.

† See Huxley 'On Crayfishes,' p. 305.

hepatica. For, calling the small black slug upon the distribution of which I have, following Schrenk and Middendorff, just been writing, "*Arion ater*," I have the example and authority of Forbes and Hanley, and I think that of Gerstfeldt. But now, following Schrenk more closely, I should call it *Arion hortensis*, and should wish to be understood to be of opinion that it will—as I hope, by means of experiments now being carried on in my laboratory by Mr. A. P. Thomas—be ultimately shown that the smaller of our two British Arions really is one at least of the hosts infested by the sheep-fluke, *Fasciola hepatica*.

As regards the distribution of the *Fasciola hepatica* in northern regions we have the authority of Leuckart, 'Die Menschlichen Parasiten,' i. p. 531, 1863, for saying that it is found in Greenland and North America; and the same excellent authority quotes, *l.c.*, ii. p. 870, 1876, Krabbe to the effect that it is not found in Iceland. The last statement is confirmed by Jonsson in 'Deutsche Zeitschrift für Thiermedicin und vergleichende Pathologie,' Bd. v. Heft vi. 1879, p. 413, in the words "Leberegeln kommen in Island nicht vor." I wish to add that there is no mention of the disease which *Fasciola hepatica* causes in Olafsen's and Povelsen's two volumes of 'Travels in Iceland,' though the diseases of sheep are repeatedly treated of by those authors.* And a similar remark may be made as to Siberia; neither Middendorff, nor Radde, nor the great Pallas, treating as they do so exhaustively of the natural history of that region, ever within my knowledge make any allusion to the existence there of *Fasciola hepatica* as a cause of sheep disease. As regards, however, the existence of this animal and of the sheep-rot in Greenland, as testified by Leuckart, I wish to lay alongside of it the following statement from the English translation of Rink's 'Greenland' already referred to, and edited by Dr. Robert Brown in 1877. There, p. 97, it is stated that about the year 1855 there were in the whole of Greenland only from 30 to 40 cows, 100 goats, and 20 sheep, and that this handful of cattle were located at Julianshaab, on the west coast. A statement to the same effect is given by Dr. Brown himself in the 'Manual of Arctic Instruction,' 1875, p. 27. Surely if the rot still exists in Greenland, and has not shared the fate of so many other forms of life which have finally left its inhospitable shores, we have in Julianshaab a simple case and a circumscribed area wherein to prosecute research.

If the presence of *Fasciola hepatica* in an isolated locality—

---

* See German translation published in 1794, i. pp. 112–280; ii. pp. 46, 198, 199.

that of Julianshaab, on the west coast of Greenland—is likely to prove instructive, its absence from Iceland may also throw some light upon the subject. Most or all of the mollusca which have been or can be supposed to act and suffer as *Zwischenwirth* for the *Fasciola* are to be found in Iceland, viz., *Arion ater*, *Arion hortensis*, *Limnæa truncatula* and *Limnæa peregra*,* as well as *Planorbis rotundatus*, if not *Planorbis marginatus*. And that abundant opportunities for the introduction of *Fasciola hepatica* into Iceland have been given by the importation of sheep from abroad is learnt from what Olafsen, *l.c.*, ii. pp. 198–199, tells us as to the ascription of another sort of sheep disease to such importation.

I incline to ascribe this immunity from rot which the sheep enjoy in Iceland to the habit which they in common with the Shetland and Orkney sheep have of feeding between high- and low-water marks upon the seaweeds specified by Olafsen in various passages, *q.v.*, *l.c.*, i. 233, 279, ii. 198, and Low, 'Domestic Animals of Great Britain,' p. 59. The *Fasciola hepatica* is a freshwater animal, and would not of course be picked up in such a locality as the interval between "Ebbe and Fluth," to which the sheep resort even on the dark nights of winter. It is possible to speculate as to the virtues of salt as an anthelminthic, and to suggest that it may act either by enabling a better gastric juice to be secreted, and so giving the sheep a better chance of digesting the larval *fasciolæ* when swallowed, or by provoking a more copious flow of bile, and so washing the young fluke out of the gall-ducts. This, perhaps, is not the place for such enquiries. But it is a pure natural history fact that localities rich in deposits of salt are favourable to the growth and health of sheep. Pallas, in the wonderful eleventh Fasciculus of his 'Spicilegia Zoologica,' dwells on this in reference to the Steatopygous variety of the domestic sheep at pp. 65–67, and with reference to the Argali, the *Ovis fera Siberica*, supposed to be the parent stock of *Ovis aries*, var. *domestica*, he writes thus at p. 12: "Omni vero tempore ubi possunt loca salsagine rorida quibus universa Siberia abundat crebro frequentant, terramque sale fœtam cavant quod cervino quoque generi solemne est."

George Rolleston.

June 25, 1880.

---

3. *Experiments with Embryo.*—The first experiment made was with *Arion ater* and *Limax agrestis*. A piece of turf was spread at the bottom of a large aquarium, and a quantity of sheep's

* See Mörch, 'Faunula Molluscorum Islandiæ,' 1868, pp. 12 and 16.

droppings, containing numerous eggs of the liver-fluke, was mixed with water, and the liquid poured over the turf, and the whole kept constantly moist. Into this, black and grey slugs were introduced. Subsequently the experiment was varied, eggs were obtained in large quantities from the livers of rotten sheep, and hatched out in a small volume of water, and the water, containing perhaps several hundred or thousand active embryos, poured over slugs confined in a small vessel. Every opportunity was given to the embryos of coming in contact with the slugs, and making their way into them. The embryos were watched under the microscope and seen swarming about the slugs, swimming around them, and occasionally stopping to bore, but one was never seen actually to penetrate the integument of a slug. I had noticed slugs feeding at the road-side on the excrement of animals, and it occurred to me that the embryo or egg might possibly be swallowed by the slug, and afterwards bore its way through the walls of the intestine into the body-cavity. Accordingly, eggs containing nearly mature embryos were strewn on cabbage-leaves and given to slugs. One of these dissected showed that the eggs escape the crushing action of the radula and jaw of the slug, for only one egg was in any way injured.

In dissecting specimens of the black slug, numbers of the cystic form of *Tænia arionis* were found, always close to the respiratory cavity, and accordingly other embryos and eggs of the fluke were injected into the pulmonary chamber of the slug.

The slugs experimented upon were *Arion ater* (more than fifty individuals), *Arion hortensis*, *Limax agrestis*, and *Limax cinereus*. These were dissected subsequently at different periods after infection, but in no case, with one exception, was any larval Trematode found. This exception was that of a black slug belonging to those first infected. It contained sporocysts belonging to *Cercaria limacis*, Moulinié (= *Cercaria trigonocerca*, Diesing). These sporocysts include cercariæ provided with boring-spine and only a rudimentary tail, and as the sporocysts are left behind in the mucous trail of the slug, Moulinié * conjectured that the cercaria of the liver-fluke might occur in some such form.

The sporocysts, as found on the surface of the slug or the track of mucus it leaves in crawling, are oval or cylindrical sacs 0·8 mm. long, with one extremity produced into a sort of neck. In the centre of this is a slight depression, and the whole acts as a rudimentary sucker. The surface is formed by a thin trans-

* 'Mémoires de l'Institut Genevois,' vol. iii. p. 267.

parent cuticle, covered with fine granules; and beneath this is a layer of circular and longitudinal muscular fibres, most strongly marked in the neck, and then a layer of delicate rounded cells, between which are numerous fine calcareous granules, which give the sporocysts a yellowish colour by transmitted, and a milky appearance by reflected light. But the most striking peculiarity of this sporocyst is the presence of an inner sac, formed by a transparent structureless membrane. This sac lies loosely within the outer cellular one, and, in those sporocysts which were seen to move, slipped to and fro within the outer contractile walls. It contains usually nine or ten cercariæ, swimming in a transparent liquid; the cercaria is provided with a boring-spine imbedded in the wall of the oral sucker, and has a very rudimentary stump-like tail. The sporocysts multiply by transverse division.

These sporocysts are not provided with any boring organ except the neck, which has been described, and the tissues of this must be very soft, but they are, nevertheless, able to penetrate the thick integument of the slug. They were observed with the aid of the microscope emerging from the whole of the fore-part of the dorsal surface of the *Arion*. First a slight tremulous motion was noticed, then a drop of milky perspiration seemed to gather upon the black surface. This was the sporocyst itself, but no very distinct movement could be noticed in it. The end carrying the neck emerged first, and, when the whole was well out of the slug's body, it fell over on one side, and lay perfectly inert and motionless. The sporocysts seemed to be aided in making their way out of the tissues of the host by the slug itself, for when this was irritated, and so caused to shed out a larger quantity of mucus, the sporocysts appeared rapidly and in large numbers. Over two thousand were given out by a single slug in forty-eight hours. They are left behind in the mucous trail of the slug, and in any moist locality the included cercariæ remain alive for a day or two. As they are thus scattered over the gronnd wherever the host crawls, they may be easily swallowed by any herbivorous animal whilst feeding. Such a mode of distribution would be highly favourable to the cercaria of *Fasciola hepatica*.

Leuckart, in his well-known work on 'Parasites,' has objected * to Moulinié's conjecture, on account of the presence in this *Cercaria limacis* of a head-spine and the associated so-called "salivary glands," which in all probability are wanting in the cercaria of the liver-fluke. The outer surface also is smooth, whereas *Fasciola hepatica* probably possesses a cuticle

* 'Die menschlichen Parasiten,' vol. i. pp. 521 and 570.

armed with fine spines from the first. And lastly, he considers it improbable that these cercariæ pass into the ultimate host without previously encysting; for the head-spine is a boring apparatus, which in other cercariæ is employed in penetrating the host in which the encysted stage is passed. But it is possible that this boring-spine may be required by the cercaria to enable it to leave the inner envelope of the sporocyst, which appears to be very tough.

However, some twenty slugs of the same lot as the *Arion* in question, which had not been exposed to infection with *F. hepatica*, had previously been dissected and found free from trematode larvæ, and the presence of a cercarian form in one of those which had been so exposed was highly suspicious. But fifty-six more *Arions* were obtained from the same source, through the kindness of Mr. W. Hatchett-Jackson, and of these two proved to be infested with the same *Cercaria limacis*. They came from a garden at Weston-super-mare, surrounded by high walls; the nearest sheep were two miles away, and the nearest rabbits a mile; so that it was highly improbable that slugs would get infected with *Fasciola hepatica* under such circumstances. In order that the question might be decided, a rabbit was fed at different times with several thousands of these sporocysts, and, after a time, its droppings examined for eggs. None were found, and when the rabbit was eventually killed, the liver was perfectly free from flukes.

Attempts were also made to infect different aquatic mollusca. Similar experiments have been carried on for particular snails by other zoologists, but always without success. Leuckart (*l.c.* p. 765) has experimented upon *Limnæus stagnalis* and *pereger*, *Physa fontinalis*, *Planorbis vortex* and *carinatus*; von Linstow * upon *Succinea amphibia* and *Planorbis vortex*.

I have experimented upon *Planorbis marginatus*, *Succinea amphibia*, *Limnæus pereger* and *L. truncatulus*. The snails were brought together with very large numbers of embryos in a small vessel, and the snails subsequently examined. Several forms of larval trematodes were found during the experiments, but none which could be connected with *F. hepatica*. Similar experiments were tried with *Gammarus pulex*, as an extremely common and generally distributed form, although the probability of this serving as host appears to be slight. Eggs also containing mature embryos were given to *Gammarus*, and were readily devoured by it. Most of the eggs, however, were crushed by their jaws, though a few uninjured ones were found in the digestive tract. But here also infection failed.

The failure of infection-experiments in the hands of different

* 'Archiv für Naturgeschichte,' 1875, p. 194.

observers leads us to inquire whether the development of the liver-fluke deviates from the type usual among the digenetic Trematoda with which it is always classed, or whether there is any cause for failure in the line of experimentation.

The genera of Trematoda in which the existence of a sporosac or nurse-form has been proved, are *Monostoma*, *Amphistoma*, *Distoma*, and *Gasterostoma*. Among Trematodes the ectoparasitic *Polystomeæ* present no alternation of generations, the egg is large, and the embryo produced from it already resembles the adult and develops into it by a simple metamorphosis. *Holostoma*, which is usually classed with the digenetic Trematodes, is in the manner of its development intermediate between the digenetic *Distomidæ* and the *Polystomeæ*. The egg is of large size, and the embryo passes through an encysted larval state in an intermediate host, and the larva is known under the names of *Diplostoma* and *Tetracotyle*—i.e. there is no alternation of generations, although there is a stage passed in an intermediate host. But here, as among the *Polystomeæ*, the embryo, when hatched, is more highly organised than those of the true digenetic Trematodes. The embryo of *Holostoma cornucopiæ*, according to von Linstow,* has a ciliated cuticle and eye-spots, as exist in so many *Distoma* embryos, but otherwise is already very like a *Tetracotyle*. The genus *Fasciola* differs but little from the typical genus *Distoma*, and although the egg in absolute size is almost the largest, if not the largest, among the Distomidæ, it is by no means the largest relatively, and there is nothing in the organisation of the embryo to encourage the idea that its development differs greatly from the typical course, or that it can be direct. Eggs of the liver-fluke have been given to sheep by Professor Simonds,† Gerlach, and other observers, and they have never incurred the rot. But these eggs appear to have been fresh, and in one case are stated to have been so, whereas a prolonged stay in water, at a lower temperature than that of the sheep's body, is necessary for the development of an embryo. I accordingly hatched out numbers of embryos, and administered them, together with eggs still containing embryos, to rabbits, but subsequent examination of the rabbits found them completely free from flukes.

It has already been pointed out that the *sporosacs* of Trematodes are only known to occur in molluscs and fish. It is conceivable that they occur, though they have hitherto escaped detection, in other animals which inhabit water or moist earth, and it may be well to extend our inquiries in this direction.

---

* 'Archiv für Naturgeschichte,' 1875, p. 187.

† 'The Rot in Sheep,' p. 17.

It is possible that the failure of experiments may be due to the artificial conditions under which the animals experimented upon are necessarily kept. Zeller relates * that he was unable at first to rear the adult form of *Leucochloridium paradoxum* in birds kept in confinement, and had to perform his feeding experiments upon young birds in the nest, which were then fed by their parents. In this case it will be advisable to repeat the experiments under improved circumstances.

4. *Investigation of "Sheep-rotting" Fields.*—The problem of the development of the liver-fluke may be attacked from another point, viz. by visiting the scene of actual infection, examining the conditions of the ground, and the circumstances which favour the contraction of the parasite, studying the fauna and examining it for larval forms of Trematodes. With this view a large number of farms have been visited in the neighbourhood of Oxford, where the outbreak of the disease was very serious in 1879–80, and some of the more interesting and important observations will be briefly noted. In these investigations I am especially indebted to valuable assistance from Professor Rolleston.

Wytham.—There was here a well-marked case of upland infection, and it appeared to be so free from sources of error, that numerous visits were paid to it, both by day and by night, and the fauna thoroughly investigated at the time which is supposed to be most dangerous for the contraction of the fluke-disease.

Rot first appeared upon this land in the autumn of 1879; the tenant had held the farm for over forty years, but had never had a single case before. He lost more than forty sheep, and even his cattle suffered from the fluke. None of the neighbouring farmers had any rot amongst their flocks. The sheep had been kept entirely on five fields, situated on the side of a hill, and quite above the reach of any floods; they were not turned on to arable land, but some hay and clover was brought to them, and their water they got in the fields. The ground on the whole appeared fairly good, most of it distinctly sloping, but it lies upon the Oxford Clay, and in places there are depressions which remain moist, or even a little marshy, in dry weather. The summit of the hill is covered with woods containing much game, and rabbits were seen about these fields in considerable numbers, and are said to have suffered severely from flukes. The disease was very likely introduced by them, as their droppings containing eggs would be spread all over the fields. A small rivulet rises in the woods above, and flows down through these fields; troughs are placed in its course, and it was from these troughs

* 'Zeitschrift für wissenschaftliche Zoologie,' 1874.

that the sheep drank. Its waters were searched for molluscs, but none found except a single minute specimen of *Cyclas* and two equally minute specimens of *Physa fontinalis*. It contained also a few aquatic larvæ—which, however, were free from Trematodes—but the only abundant form of animal life was *Gammarus pulex*. Some of these Gammari contained thin-walled oval cysts, including immature distomes which have been described but not named by De la Valette.* The surface of this distome is marked with fine granules, as is probably that of *Fasciola* from the earliest period, but the oral sucker is considerably larger than the ventral, and some other points in its anatomy are against the view of its being the larval form of the liver-fluke. *Limax agrestis* was fairly abundant in the fields, and *Arion ater* occurred in smaller numbers, more especially on the margin of the wood, but the dissection of a score of each species and microscopic examination of all their tissues did not reveal a single larval Trematode. No water-snails could be discovered in any of the other ditches, and the only other animals found on these fields, which need be mentioned here, inhabited one of the wet places referred to above. Here two or three small specimens of *Limnæus truncatulus* and some aquatic larvæ were found. These contained no cercariæ, but in another *L. truncatulus* found at the same spot a month later, an interesting form of cercaria occurred. It has certain points of resemblance with both *Cercaria agilis* and *Cercaria tuberculata* of De Filippi,† but appears to be a new species. It is produced in a cylindrical redia, 1·3 mm. long, with two short conical processes at the posterior end. The young rediæ have in addition two similar but smaller processes near the anterior extremity, and there is an opening which gives exit to the cercariæ just in front of one of them. The digestive tract is well marked, but short and of a clear yellow colour; its length is almost constant in the rediæ of different ages, and is 0·22 mm. The pharynx is distinct. The mature redia contains one, two, or three cercariæ, and germs of others. The free cercaria has a body of oval form, about 0·3 mm. long, but is of very changeable shape; the tail is more than twice as long as the body. The oral sucker is subterminal and 0·06 mm. in diameter; the pharynx is distinct and 0·034 mm. in diameter; the ventral sucker is central, about the same size as the oral, or but little larger. Digestive tract simple and forked. There is no head spine, and the anterior part of the body is covered with exceedingly minute spines. On each side of the middle line, extending the whole length of the body, is a white

* 'Verhandlungen des naturforsch. Vereins d. preuss. Rheinlande,' 1859, p. 56.

† "Memorie della Reale Accademia delle Scienze di Torino." Serie II. vol. xviii. p. 206.

opaque structure, seemingly made up of granules arranged in rounded masses. These granules are dissolved by acids without effervescence, leaving an albuminoid basis; one would most naturally refer them to the lateral excretory organs, but no vessels can be distinguished. The cercaria is very active but soon comes to rest, and shows a strong tendency to encyst itself upon surrounding objects. It contracts so as to assume a spherical form, and exudes a mucous substance, containing numerous opaque granules, which are those previously forming the white lateral masses. The cysts are snowy white by reflected light, but on rupturing them the included distoma is found to be quite transparent.*

The structure and habits of this cercaria render it possible that it may prove to be the larva of *Fasciola hepatica*, but want of material has prevented my testing the question by giving the cysts to rabbits. I intend, however, to pursue this case further, and am indebted to the Earl of Abingdon for free access to his estate in investigating the source of the infection.

Frilford.—Certain low-lying fields were visited here which gave the rot in 1879 for the first time during twenty years. The sheep had been divided into three flocks, and one of them placed on meadows near two small streams, in the middle of August. All these were badly rotted and had to be killed before the end of October. This part of the ground is flooded regularly in the winter, but such a flood is not dreaded: it was the summer-floods of 1879 which gave rise to so much mischief.

On some adjacent fields one of the other flocks was rotted, as well as heifers, though not so rapidly. This land does not lie so low, but is irrigated, and is very damp. Lambs were placed here last summer, for, as there had been no summer-flood, it was supposed to be quite sound. The owner was strongly urged by Professor Rolleston to remove them to higher ground, and all except three were accordingly removed. These three were kept, by way of experiment, upon the fields until the end of August, when, food becoming scanty, they were driven on to drier ground. One of these was slaughtered two or three weeks later, and was found to contain young flukes.

Three species of land-molluscs were found here in great abundance, viz. *Arion ater*, *Limax agrestis*, and *Succinea putris*,

---

* The tissues of the cercaria contain numerous rod-like corpuscles 0·006 mm. long, closely resembling bacteria in form but without movement. De Filippi (*l.c.* vol. xvi. p. 432) found similar corpuscles in the cercaria of *Amphistoma subclavatum*, and as they disappear in the adult he suggested that they might aid in forming the cyst. But I found them still present in cercariæ which had been encysted a fortnight.

and a large number of them collected and examined at the time when it is known that the germs of the fluke were about the ground, but no cercariæ were discovered. In the irrigation trenches and the two brooks many kinds of water-snails were discovered, and some of them (*L. pereger*) contained trematodes, but none traceable to *Fasciola.*

Stratton Audley.—In a lamb's liver from this place a great number of minute flukes were discovered, and as they had evidently entered the liver quite recently the case was followed up, and the ground where the lamb had been reared was visited. The farmer had lost all his ewes by rot the previous winter: the lambs had to be weaned very soon, and the mothers sold for a few shillings each. For the last three months the lambs had been kept exclusively in four fields, which lay partly on the Cornbrash and partly upon the Oxford Clay. The ground on the whole seemed in good condition, but in some of the lowei parts upon the clay was obviously damp, as was shown by a few scattered rushes growing there. No part of the ground was subject to long-standing floods, but during heavy rains the water had some difficulty in getting away, and on such occasions would stand for a short time on the lower parts of the meadows. About an acre had been so covered for a few hours after some heavy rain at the end of August, four weeks previous to my visit. At the bottom of the fields flowed a small rivulet, but this contained nothing beyond *Gammarus pulex* and two or three small grey slugs, which were bathing themselves after the wont of this species. The ditches were mostly clean, but one contained many specimens of *Succinea amphibia* and *Planorbis discus*, and after much search two or three specimens of *Limnæus pereger*, *L. truncatulus* and *Pisidium* were discovered. The black slug was scarce, and only one specimen could be procured; but the most striking feature in the molluscan fauna was the excessive abundance of *Limax agrestis* scattered over the fields and crawling up the stalks of grass. More than thirty of these grey slugs were dissected, but nothing could be found in them. The only larval trematodes obtained here were *Leucochloridium* in *Succinea*, *Distoma* sp. in *Gammarus*, and in one only out of twenty-three specimens of *Planorbis discus* a species of *Histrionella*, apparently undescribed as yet. It is found in small flask-shaped rediæ, the body is depressed and oval, the hinder border emarginate; on the back are two, or at a later stage three, black eye-spots. The tail is simple and filiform, two or three times as long as the body, and very contractile, and the animal shows a great tendency to encyst upon surrounding bodies. The *Histrionella* might possibly have some connection with *Fasciola*, but most probably has not.

In addition to these, numerous other cases have been examined. At Woodeaton certain fields have been known to give the rot regularly for more than five years. *Arion ater* was the commonest mollusc here, and many specimens were examined. The road leading to Oxford over Woodeaton Common has a very bad reputation for giving rot, but more than a score of the same slugs (and these were the only molluscs discoverable) afforded no trematodes.

A consignment of slugs was received from a field in Lincolnshire notoriously liable to flukes, which is surrounded by ditches containing brackish water, which occasionally fills them for months together. The slugs comprised many species of *Arion ater* and *Limax agrestis*, with a single *Arion hortensis*, but none of them contained any cercariæ. From sheep-rotting fields at Swindon *A. ater*, *L. agrestis*, *Limnæus truncatulus* and *Succinea amphibia* were obtained, and slugs have been obtained from similar localities at Abingdon and Hincksey, but none of these contained any cercarian form.

It will be seen that large numbers of our two common slugs have been collected at a critical time from infected ground, and all have proved to be free from any form of trematode, whether in the brood-sac or encysted state. The only cercaria met with in any slug during the investigation is *Cercaria limacis*, and this is, indeed, the only one which has been described in *A. ater* or *L. agrestis*, except some free but immature distomes found by Dujardin, and which have probably nothing to do with *Fasciola*. In aquatic molluscs cercarian forms are in certain localities very abundant, and I have not found any sheep-rotting ground where careful search has not revealed some water-snails, though in some instances they have been scarce, as at Wytham. In these one or two suspicious forms have been discovered, but they have not been abundant enough to enable me to perform the necessary feeding experiments upon rabbits.

The failure to find the cercaria of *Fasciola* even in the very large numbers of molluscs which have been worked upon furnishes us with negative evidence only; and in this connection it must be remembered that where the larval forms of trematodes do occur, they are frequently found in vast numbers in a single host. As many as 10,000 cercariæ may be given off in a single day by a slug infested with *Cercaria limacis*.

One of the conditions most necessary for the prevalence of rot is moisture; and whilst low-lying ground is thus naturally more exposed to it, rot may occur on upland (as at Wytham) if there be sufficient moisture to allow the egg of the fluke to develop; that is, any heavy or ill-drained land may give the rot. In the neighbourhood of Hampton Poyle and Bletchington, north of

Oxford, the rot has followed the geological character of the ground very closely. All fields upon the Oxford Clay have been dangerous, whether exposed to floods or not. On the other hand, floods on low porous ground or on gravel appear to do no harm, unless the water stands for a long time. All this is easily intelligible when we remember the necessity of moisture for the hatching of the embryo. Winter floods are not necessarily dangerous, because warmth is required as well as wet.

Surprise is sometimes expressed at the way in which the rot breaks out in a wet season suddenly in isolated flocks. The eggs of the fluke must be present on the ground, or rot cannot occur, but the distribution may take place in many ways, as by floods or running water, or in manure. Rabbits also have much to answer for in distributing the parasite. Everywhere about Oxford the same account is given of the way in which these animals have suffered from the rot, and in some neighbourhoods they have almost been exterminated. I have received livers of fluked rabbits and have found them to contain as many as forty or fifty flukes. Wherever they go, and they often wander far from home, the eggs of the fluke are distributed in their droppings, aud the first condition for the existence of rot is satisfied.

Practical men seem to have come to the conclusion that the rot is particularly due to close grazing, and that those animals suffer most which can bite the nearest to the ground. A sheep can graze where cattle or horses can get nothing (indeed, it can graze closer than any other animal except a kangaroo), and some farmers ascribe to this cause the special liability of sheep to fluke-disease. "Hog-jawed" sheep are known to escape the rot when all the rest of a flock take the infection. Lambs suffer more than older sheep, and this may be due to lesser digestive power, which does not enable them to digest the germs of the fluke; but one good observer has told me that at Michaelmas of the year in which a lamb is born, it can graze closer than an older sheep, quite down into the roots of the grass, and would do fairly well where an old ewe would starve. Hence he attributes the liability of lambs to rot partly to their grazing so closely. This generalisation, if true, indicates that the germ of the fluke is picked up close to the damp roots of the grass.

But whilst the general conclusions to be drawn from the accounts of untrained observers are often valuable, and afford suggestions for accurate research, there is much danger in accepting them too quickly. Extreme difficulty is often met with in eliciting the truth in matters of fact, and the following instructive instance shows the necessity for the utmost caution in making enquiries. A remarkable case of sheep-rot was heard

of, and the owner was visited and full enquiries made. We were told that sheep and lambs had been kept side by side in separate flocks, and within hurdles the whole of the summer and autumn; the sheep had followed the lambs over the same ground, but although the conditions under which they had been kept were so closely similar, the whole of the lambs had taken the rot, whilst not one of the sheep suffered. There had been heavy rains at the end of July and the beginning of August, and, owing to the blocking-up of a drain, the ground within the hurdles had been covered for some time with several inches of water, and the owner fully believed that the rot was taken then. But he could not explain why the lambs alone had suffered. Particular enquiries were made as to the subsequent history of the different flocks, and we were told that in September they had been taken to higher ground, and had all been kept within hurdles upon clover, roots, &c., until the end of the year, when the rot showed itself among the lambs. The case was so remarkable that a second visit was paid to investigate the fauna, and this time we questioned the shepherd, and from him we got information which completely solved the difficulty. At the end of September he had driven the lambs to another farm, whilst the sheep remained at home. The lambs were on the journey five hours, and remained away seven or eight weeks; they were in good condition on their return, but the rot appeared among them soon after Christmas, and they went very fast. There can be no doubt that the rot was taken at the other farm or on the road; this is confirmed by the date at which the disease appeared, and by the fact that the sheep of a neighbouring farmer on lower and wetter ground did not suffer at all. The owner had quite made up his mind that the rot was taken in July and August, and this had in some way caused him to give us misleading information. He had been anxious to assist us in every way, but had either forgotten the journey, or else disregarded it as irrelevant to the question.

5. *Growth of the Fluke, and the Duration of its Life.*—A lamb's liver was received on September 24th from Stratton Audley. The surface was of the normal colour, except where it was marked with red inflamed spots, and with white ragged bits of connective tissue, which are considered by those who have had much experience in slaughtering to be extremely characteristic of the earliest stages of the rot.

This liver was said not to contain any flukes, but did contain over two hundred, all immature, the largest only one-third of an inch in length. Many flukes were obtained from the surface, some projecting from holes, others visible immediately beneath the peritoneum; and from openings on the surface a red ooze,

containing a young fluke about one to three lines long, could be pressed. When a cut was made into the liver, the surface had a mottled appearance, due to a solid yellow substance, and to small spots where the substance was inflamed or destroyed, and reduced to a red ooze. The bile-ducts could hardly be said to be enlarged, and no flukes of any kind could be found in the larger ducts. By far the largest number were in the smaller branches of the bile-ducts, or in centres of destroyed hepatic tissue. They occurred especially near any surface of the liver. The young fluke on entering the liver by the bile-duct appears to push its way onwards into the smaller ducts, where some remain, whilst others penetrate the walls of the ducts and crawl forwards to the surface, causing the destruction of the parenchyma as they proceed. Arrived at the suface of the liver, they may pass along beneath the peritoneum, as may be seen from the long inflamed tracks which they leave behind them, or they pierce the peritoneum and set up perihepatitis, and the consequent adhesion gives rise to the ragged patches of connective tissue visible on the surface of the liver when this is removed from the body. The flukes may also be found in the peritoneal cavity of the animal, as I have seen them in a rabbit. In another case, where all the flukes present were of full size, and atrophy of the hepatic parenchyma had made some progress, several flukes were found at the thin free edge of the liver, with the anterior part of the body projecting into the peritoneal cavity. The power of the fluke to wander within its host seems to be greater than is generally supposed. Mr. A. H. Cocks informs me that on examining a Welsh ewe which had died from the rot, he found several flukes in folds of the mesentery, and others in the uterus.

The smallest flukes I have been able to discover were found in this liver; the two least measured 1·1 and 1·25 mm. long, and a good many others were little more than 2 mm. long. The appearance of such small forms may form some guide in searching for the cercaria. The digestive tract was already very much branched, though to a less extent than in the adult; the spines covering the body were present, but extremely fine. In the one measuring 1·1 mm. in length the anterior part of body measured 0·4 mm. only, the posterior part 0·7 mm.

Leuckart (*l.c.* p 573) conjectures that the liver-fluke occupies only three weeks in arriving at maturity. But the lamb just mentioned had been removed from the source of infection 6½ days before it was killed, and in the interval had been kept on dry ground, where rot could not be contracted, and yet some of the flukes measured little more than 1 mm., and the largest was only 8·5 mm. long. A lamb of the same flock was killed nine-

teen days later, immediately after it had left the infected field. The greater part of the liver was still of the normal colour, but was marked with yellow spots and small lumps, and mottled with red patches which on pressure exuded a red ooze. The bile-ducts in the hilum of the liver were hardly thickened or dilated, but in the more distant parts were thickened just for an inch where a fluke lay. None of the flukes were full-sized, though two or three were 20 mm. long and contained ova, whilst the majority were not much more than 8–14 mm. long, and the smallest measured only 2 mm. In another case the flukes contained in the liver of a lamb killed 2½ weeks after removal from the source of infection, measured 6–10 mm. in length. From these and similar observations I believe that the fluke takes five or six weeks in attaining sexual maturity. At the time it enters the liver it is probably less than 0·5 mm. long.

Duration of Life.—The liver-fluke is supposed to pass out of the sheep at the beginning of the summer, i.e. its life lasts only three-quarters of a year. Gerlach says that the fluke always passes out in the months of June and July, but Pech * states that he saw flukes pass out from rotten sheep in the autumn and winter, and suggests that they may have lived in the sheep more than a year. I have examined the droppings of sheep in June, which were asserted to contain dead flukes, but the so-called flukes proved on microscopic examination to be masses of mucus of very much the same colour as a fluke. The question is one of great importance, for if the fluke can live more than one year, it will scarcely be worth while attempting to keep the sheep alive until the natural limit of the fluke's life is reached. Three ewes which took the rot in the autumn of 1879, were received at the Royal Agricultural College, Cirencester, and have been under treatment since February 1880. The case has been described by Professor Mayer, in a lecture since published. The first was killed in April, and in December the other two were passing great quantities of ova, and as one of them appeared weakly and likely to die, it was killed on the 18th. The bile-ducts were filled with flukes, and others occurred in the gall-bladder and in the commencement of the intestine.

I am indebted to the courtesy of Professor Stuart for one-half of this liver, and in this portion found 100 flukes. The bile-ducts were thickened, as usual, and the liver was pale, but there was no atrophy of the hepatic cells, and there was much less connective tissue than is usually found in a liver where the disease is of such long date. This was no doubt due to the care and generous diet bestowed upon the ewe, and if the fluke

* 'Thierarzt,' 1873, p. 87.

could only have been got rid of, there was nothing to preclude the possibility of the liver being again serviceable. But on the other hand, there was nothing in the appearance of the flukes to suggest that they were drawing near the natural limit of their lives. Both digestive and generative organs were in full functional vigour, the oviduct was filled with eggs, and there was no indication of any exhaustion of the supply. The ewe had been kept under conditions which render re-infection highly improbable, and it follows, therefore, that *the life of the liver-fluke may extend beyond one year.*

Conclusion.—The necessary conditions for the existence of rot in any given locality where sheep are kept are (1) the presence of the eggs of the fluke, (2)water or wet ground during the warmer months to enable the embryo to hatch out of the egg, (3) the presence, it is believed, of slugs or snails upon the ground to secure the further development of the embryo and the production of the cercarian form which eventually enters the sheep.

If any one of these conditions be not satisfied, there can be no rot. Very little attention is paid to the eggs of the fluke, but these, like the eggs of all entozoa, should as far as possible be rigorously destroyed; if we can effect this we shall prevent the rot. The eggs are present in immense numbers in the droppings of infected animals, and hence are distributed wherever such animals are kept. Unless sheep are very valuable it may be better to kill them instantly they are known to be infected; for we shall thus prevent the production of more eggs and the propagation of the fluke. The cure of the sheep, if cure be possible, will probably cost more than it is worth. If rotted sheep are kept in a yard, the manure should be collected, and never spread upon damp ground. The eggs may be hindered from developing by adding a little coal-tar oil to the manure, and keeping it for some time before it is spread on the fields. Or, the manure may be spread on dry, well-drained ground. Above all, livers of fluked sheep should be destroyed, for if every egg succeeded in producing one fluke, a single liver might contain sufficient eggs to destroy a flock of 50,000 sheep. Fortunately the chances are immensely against any egg giving rise to an adult fluke, but we should do all we can to increase these adverse chances.

With regard to the second condition for the existence of rot, the obvious remedy is that the land should be thoroughly drained. The third condition is the presence of slugs or snails. It has not been possible as yet to prove the presence of the cercaria of the liver-fluke in one or more particular slugs or snails, but for reasons already given, there is no ground for doubting its existence. Hence all slugs or snails on sheep-rotting fields

should be destroyed. A dressing of lime will destroy both the eggs of the fluke and the snails or slugs. But upon this point I may refer to a paper which was drawn up by Professor Rolleston during last June, and is here appended.

I hope to have the opportunity of completing my experiments, and discovering the cercarian form of *Fasciola hepatica*, but in the mean time it has been considered desirable to publish the observations already made.

In concluding I desire to express my thanks to all those gentlemen to whom I have had occasion to apply for assistance. I have always found them most courteous and ready in supplying all information desired, and in facilitating in every way the investigations on their fields.

A. P. THOMAS.

Jan. 1881.

PREVENTION OF ROT.

There can scarcely be any doubt whatever that for the maintenance of rot in sheep and of a breed of flukes, the presence on the same ground of a breed of snails is requisite. It is certain that sheep do not get "gid" or "sturdy" if dogs are not used for shepherding; and it is all but, if not quite, as certain that sheep will not take the rot if they do not feed on certain pastures infested with certain snails. Rot and "gid" each depend upon a parasite, a different one in each case, but each parasite is like the other in requiring, if it is to live its life, to find lodgment at two different times of that life in two different animals.

To stop fluke disease, as to stop gid, it is only necessary to break one link in the chain of events which make up the history of either disease. If we can destroy the snails or slugs, which the fluke must inhabit at one time of its life if it is to infest the sheep at a later period, we shall stop the rot.

There are many kinds of snails; and some on thoroughly dry pastures, such as the Downs, have nothing to do with harbouring our flukes at any stage of their lives.

Therefore, if we feed sheep on, or with food from, such pastures only, we shall not have rot.

But in wet seasons almost any pasture may be made dangerous by infection.

And the eggs of flukes may be dropped on to a field not only by rotten sheep and oxen, but by hares and rabbits; and, further, we may ourselves carry it there in manure. When once there, the eggs may remain as such and do no harm.

But if, firstly, there is warmth enough to enable them to

hatch, and wet enough to let them hatch in water; and if, secondly, there be snails on such damp ground, sheep may get the rot there. And ground once infected is not safe again for more than one year.

Fields may be freed from snails and slugs by scattering cabbage-leaves along the sides of the hedges and elsewhere, and collecting in the morning the snails which will be found on the under side of them.

Slates, large stones, and boards laid on the ground and slanted up so far as to allow the slugs to crawl under them for shelter by day, would be similarly useful.

Pigs will feed on snails and slugs, but ducks, geese, and other birds will both collect and consume them.

Snails and slugs may be prevented from crossing on to a pasture by dressing a width of two or three yards round it with coal oil or dead oil, a refuse product cheaply procurable from gas-works. This could be easily done by dragging a hurdle fitted with thorn twigs, or better, with rope swabs or hempen tangles, well soaked in coal oil, round the pasture.

Soot, fine sand, cinders, chaff from barley, tan, or quicklime, spread over a belt of ground and kept dry, might prevent snails from crossing it into a pasture inside it. These latter recommendations are specially valuable at the present season, when the slugs have scarcely left the protection furnished by hedges and broken ground, the specially dangerous character of which is indicated by the well-known fact that sheep are peculiarly liable to incur the rot by feeding upon roadside strips of grass.

Much has been recommended in the way of dressing the whole of a suspected pasture with lime and other chemicals, but what will succeed in keeping snails away from it, will probably spoil it for sheep, at least for a time.

(Signed) GEORGE ROLLESTON.
A. P. THOMAS.

Anatomical Department, University Museum,
Oxford, June 21, 1880.

II.—*Report on an Experimental Investigation on Anthrax and allied Diseases, made at the Brown Institution.* By W. S. Greenfield, M.D., F.R.C.P., Professor-Superintendent of the Brown Institution.

In my former Report, published in Vol. xvi. Part 1 of the 'Journal of the Royal Agricultural Society,' I stated the results of experiments on which I had been engaged with the view of discovering a method of preventive inoculation of this disease. The experiments were then incomplete, and it was impossible to draw any positive conclusions from them. In the present Report I propose to detail the further experiments which I have made, and to state the conclusions at which I have arrived.

The method of inoculation employed was that of injecting a small quantity of the blood or spleen of a rodent animal which had died of Anthrax—the guinea-pig being that used for the purpose—beneath the skin of a bovine animal. It was found that severe febrile symptoms were induced, but that although a fatal issue was sometimes apprehended, death did not ensue (save in one exceptional case), but a complete and rapid recovery. So much having been definitely ascertained, it was my object to discover whether any protection from subsequent attack had been attained; in other words, whether the system of the animal was resistant to subsequent inoculation, and also what was the duration of the protection. For it is obvious that a procedure which only conferred protection for a short time would be of but little value in warding off the attack of so prevalent a disease as splenic fever. Moreover, I hoped, if opportunity offered, to submit inoculated animals to infection in localities where the disease was prevalent, in order to test the value of the inoculation in protecting from the disease which arises from contagion in the ordinary way.

It has happened that I have been able to expose some of the animals which had been inoculated to a source of contagion of unusually defined and virulent character; and the results have completely confirmed the anticipations grounded on previous experiments. I have been able also by comparative experiments to test the efficiency of inoculation in a striking manner.

In the course of these experiments it has been my endeavour to ascertain whether any modification of the poison of the disease could be artificially produced without the employment of animals for the production of the modified virus. With this object I have made a series of experiments, cultivating the virus arti-

ficially in organic fluids ; and I have been able to prove that it is capable of gradual attenuation, even to the degree of complete destruction of its virulence, and that it may thus be gradually modified, so that a certain degree of poisonous activity may be attained at will. As yet I have not been able to make any complete series of experiments on bovine animals by this method, as it seemed to me desirable first to obtain very precise results with smaller and less costly animals.

Inoculation Experiments.

In order to give a complete survey of the experiments on bovine animals, it will be necessary to refer to two of the cases given in my previous Report, as some of the experiments here detailed were performed upon the same animals. Case I. of the former Report will be mentioned as A, and Case III. as B. The remainder are fresh cases, and will be described as C, D, &c. I shall first mention the experiments upon C and D, two young heifers of about the same age and size, both in good condition, upon which comparative observations were made.

Heifer C : Experiment 1.—The first inoculation was made with the cultivated *Bacillus anthracis* of the third generation, prepared in the manner described in my previous Report. One minim of this fluid, containing rods and spores of *Bacillus anthracis*, was injected at 3 P.M. beneath the skin of the shoulder. No symptoms were observed until the forenoon of the following day, when the animal was found to be stupid and drowsy, with rapid respiration. Some local swelling was observed at the seat of inoculation, and this extended on the following day to the whole shoulder and forelimb. The course of the symptoms will best be seen by the following table of temperatures :—

Day of Inoculation.	8 to 9 A.M.	1 to 2 P.M.	7 to 8 P.M.
	°	°	°
1	..	..	101·6
2	101·4	105·2	105·4
3	105·8	105·8	106·6
4	104·2	104·8	106
5	102·8	..	103·4
6	101	..	102·4
7	101·2	101·2	101·6
8	101	..	..

The symptoms, both local and general, closely corresponded with the course of temperature here described. During the

persistence of high temperature (over 104° F.) there was great dulness and prostration, and loss of appetite, and a considerable local swelling. With the subsidence of the fever there was rapid recovery of general condition and appetite, and a diminution of the local swelling. In the course of two or three days the animal appeared to have entirely recovered.

It must be observed that neither in this nor in any other case was there any pustule upon the surface of the skin; there was local swelling, redness, and tenderness, and general inflammatory œdema, but nothing like the malignant pustule of the human subject. Nor had the local swelling any resemblance to the emphysematous swelling of black quarter. Blood from the ear could not be found to contain any bacilli; nor did its normal characters appear affected.

An interval of ten weeks was now allowed to elapse, during which one inoculation was made with the thirteenth generation of cultivated virus—material which, as I shall show later, is absolutely innocuous, and in this case produced no effect whatever. At the end of the ten weeks, the animal being apparently in perfect health, it was again inoculated; this time from a guinea-pig which had died of anthrax. The spleen of the guinea-pig, which was much swollen and very soft, and swarmed with bacilli, was reduced to a pulp and mixed with a drop or two of water, and the entire quantity injected beneath the skin of the flank. Not the slightest symptom, either local or general, followed this inoculation: there was, of course, a small swelling produced by the presence of the injected fluid, but neither redness nor tenderness, nor in fact more effect than would be produced by the injection of so much water.

We may now turn to the experiments in the next case, leaving the further observations on heifer C for comparison with those on heifer D at a later period.

Heifer D, an animal of the same age and size as heifer C, was kept under exactly similar conditions. Five days after the inoculation of heifer C with the 3rd generation of cultivated bacillus, heifer D was inoculated with the 8th generation in active growth. A very slight rise of temperature (1° F.) was observed on the following day, but the same had occurred before without any obvious cause, and there were no symptoms. Subsequent experiment rendered it almost certain that the material was inert. A further inoculation a week later with the 7th generation was likewise without definite effect, beyond a small local swelling. When heifer C was inoculated with the 13th generation, heifer D was also similarly inoculated, but this

material, as before stated, was quite inert. But it was thought possible that the inoculations with a very attenuated virus might possibly have conferred a certain degree of protection, and more importance was attached to the slight rise of temperature observed at the time of the first two inoculations than proved to be warranted by subsequent inspection of the entire temperature record.

Three months (thirteen weeks) having elapsed since the first inoculation, and both animals being in perfect health and with normal temperature, an opportunity occurred for direct inoculation with very virulent material. This was the blood of a man who had died of general anthrax, of the form known as "wool-sorters' disease," a disease identical with the splenic fever of cattle, and produced by the contagion derived from the skin and hair of animals which have died of splenic fever. I shall have occasion, later, to refer to this disease, and to the important bearing which the facts revealed by the inquiry in which I have been engaged on behalf of the Local Government Board have upon the prevalence and spread of the disease amongst cattle.

The blood used for the inoculation was taken from the body twelve hours after death, and received by me and used thirty-six hours after death. It was still fluid and of natural colour. Both the red and white corpuscles appeared natural. In it were seen a few very long motionless bacilli, varying in length from $\frac{1}{500}$th to $\frac{1}{125}$th inch, and about $\frac{1}{20000}$th inch in diameter. They were motionless, curved or flexuous, being thrown into curves by the movements of the fluid in which they floated. By the aid of reagents, or with special illumination, they could be seen to be made up of shorter segments, not yet separated, these segments being of the usual length of anthrax rods commonly seen in the blood of animals. No spores were seen either in the rods themselves or free in the blood. There was no putrefactive odour in the blood, nor were any other bacteria discovered in it. Inoculation of rodents gave rise to typical and rapidly fatal anthrax, differing in no respect from that produced by similar inoculation from bovine splenic fever. It is important to mention these facts, as evidence that the symptoms produced were not of the nature of ordinary septicæmia from putrid blood, nor any other communicated human disease.

Of this blood half a drachm was injected into each of the two heifers C and D, the quantity in each case being divided into two parts and separately injected into the subcutaneous tissue, in order to ensure a more complete absorption.

The results are most strikingly shown by a comparison of the

temperature records, side by side. The inoculation was made at 4.30 P.M.

DAY.	Heifer C.			Heifer D.		
	8 to 9 A.M.	1 to 2 P.M.	8 to 9 P.M.	8 to 9 A.M.	1 to 2 P.M.	8 to 9 P.M.
(Inoculated at 4.30 P.M.)	°	°	°	°	°	°
1	..	..	101·6	..	..	102·6
2	103·2	103·4	103·2	105·6	107·2	106·2
3	102	102·2	102·6	105·4	105·2	105·6
4	101·8	..	102·2	104·2	104·2	104·8
5	102	..	102·2	103·6	..	103
6	102	..	102·4	103·2	..	104·4
7	102	..	102·2	104·4	..	104·4
8	102·2	..	102·4	104·4	..	104
9	102·2	..	102	103·4	..	103·6
10	102	..	102·4	103	..	103·2
11	102·2	..	102	102·6	..	102·8
12	101·8	..	101 4	102	..	102·4
13	101·4	..	101·8	101·6	..	102
Normal range of temperature for preceding three months	101·4 to 102·4	..	101·6 to 102·4	101·6 to 102·4	..	102 to 102·6
Average temperature	101·7	..	102	101·8	..	102·3

It would scarcely be possible to show a more striking contrast than is afforded by these temperature records, and they are an exact parallel of the symptoms observed. In order to avoid the error which might arise from a slight variation, the diurnal range for the preceding three months is given in each case, and also the average for the entire observations during that period.

In the case of the heifer C, which had been inoculated successfully three months before, there were practically no symptoms whatever. There will be seen to be a rise of temperature of less than 1° on the day succeeding the inoculation, and there was a small swelling at the seat of each injection, as might have been expected from so large a quantity of blood. At one of these points a small phlegmon subsequently formed, but gave rise to no trouble.

In the heifer D, on the other hand, very severe symptoms were induced, more intense than in any of the other inoculations, and of such severity that the life of the animal was despaired of for two days. I ought here to observe that, had I been at the moment fully alive to the very small degree of protection which the animal had received, I should not have ventured on the

performance of the experiment; but I had attached too great an importance to the fact of previous inoculations.

The onset of the symptoms took place in about twelve hours from the inoculation, but it was not until twenty hours that the case appeared at all critical. From that time, however, the animal appeared completely prostrate, and scarcely able to move, and was apparently at the point of death. There was much local swelling, which involved the shoulder and forelimb. On the fifth day, when the general condition had considerably improved, this swelling was so considerable that it was found necessary to make incisions into it, and to treat it locally with hot fomentations, under which rapid improvement and recovery ensued. It may be to these incisions that the slight after-rise of temperature was due.

The nature of this local swelling is a matter of some interest. As in all the cases which I have seen, it consisted of a gelatinous looking œdema of the subcutaneous tissue and fasciæ. I was unable to discover bacilli in the fluid expressed from it.

Perfect recovery rapidly ensued. The experiment, severe as it seemed, can hardly be regretted, as it afforded so complete a test of the protection afforded by the inoculation in the heifer C.

The evidence of the protective value of inoculation as a safeguard against subsequent inoculation, at any rate within a limited period, having been so conclusively established by these and previous experiments, I had no hesitation in submitting the same two animals to another comparative test a month later. The opportunity was afforded by the occurrence of an outbreak of splenic fever at Harden, of which I shall give particulars, and which arose in connection with the washing of infected wool and the distribution of the waste water as sewage upon the farm. Blood from the spleen and the pericardial serum of a cow which died of the disease, were employed. The nature and virulence of the disease were fully determined by inoculation of rodents with the same fluids, but it may be remarked that the blood from the spleen was more active than the pericardial serum.

Heifer C was inoculated with about 20 minims of blood from the spleen; heifer D, with a similar quantity of pericardial serum, the injections being made in the same manner as before.

Although in the case of the heifer C, a rise of temperature of $\frac{1}{2}^{\circ}$ to 1° on the following evening was registered, there were absolutely no symptoms in either case; and it may be that this slight rise was rather due to the greater solidity of the material employed and consequent local irritation, than to any general absorption of the poison.

INOCULATION of HEIFERS C and D with FLUIDS from a Cow which DIED of ANTHRAX.

Day of Inoculation.	Heifer C.		Heifer D.	
	8 to 9 A.M.	8 to 9 P.M.	8 to 9 A.M.	8 to 9 P.M.
1	..	101·8	..	102
2	102·2	103·4	101·6	102
3	102·4	103	101·4	101·8
4	102·4	102·4	101·6	101·8
5	101·6	102·2	102	101·8
6	101·8	102	101·4	101·4
7	101·8	102·8	101·8	101·6
8	101·8	..	101·4	..
9	101·6	..	101·4	..

We must now return to the animals previously inoculated, A and B. In the case of A, as I mentioned in my previous Report, very severe tests had been applied to test the efficacy of the first inoculation as a protection against subsequent inoculation, and the result showed that, within the limited period over which the experiments extended, the protection conferred was complete. It was therefore decided to wait for a considerable time before submitting this animal to any fresh tests, lest it should be objected that the protection conferred was only temporary and was maintained by the subsequent inoculations, although they produced no visible effect. Similarly, with B, some little time was allowed to elapse before the application of any severe test, one or two inoculations with the cultivated virus alone being used. These, which were with the seventh and eighth generation of the bacillus, produced no effect whatever. Five months having now elapsed, one drachm of blood from the heart of the sheep which had died of anthrax, swarming with bacilli, was injected beneath the skin of the shoulder without any effect. It must be mentioned that the temperature of this animal was found to be subject to such variations that the records do not give a correct idea of the results of the experiment.

The subsequent observations on these animals consisted merely in placing them under known conditions of contagion. These will be described when I have mentioned the circumstances under which this was possible, afforded by the occurrence of a considerable number of cases of wool-sorters' disease at Bradford. It will be necessary to give a brief account of this outbreak.

It had been known for many years that the operatives in large wool factories where foreign wools were much used were liable to a form of fatal blood-poisoning, which appeared to be

due to infection from the wool, for those who suffered from it were those who had especially to do with the wool or hair in its raw state, such as the unpackers and sorters. The nature of this disease was not understood; by some it was regarded as due to the decomposition of animal matter adhering to the wool, by others as produced by the inhalation of particles of the hair and wool-dust, giving rise to a low form of inflammation of the lungs. It would be out of place here to discuss fully the precise conditions and symptoms of the disease as affecting the human subject. But, as I hope to show, the facts revealed by the inquiry have a very important bearing on the diseases of cattle, in addition to their immediate value in relation to the present inquiry.

The fatal forms of disease observed among the wool-workers, especially the sorters, may be said to be three: first, a rapidly fatal blood-poisoning without any definite symptoms; second, a form in which the lungs, and sometimes the throat, are especially affected; and, thirdly, ordinary malignant pustule. The fact that all these are simply various manifestations of the same poison, anthrax, has been absolutely determined by the investigation recently made; and these forms of human disease are characterized by symptoms analogous to those seen in cattle and horses in splenic fever or charbon. It was therefore evident that the study of the causes and mode of infection in the human subject might throw some light on the analogous conditions in animals, and unexpected revelations have shown that not only may the disease be directly propagated to animals by the infected wool, but that there exists in constant operation in connection with these factories a means of distributing the disease to farms throughout the country.

The kind of wool or hair which is found to be most deadly in its effects—the largest number of cases occurring amongst those who have to sort it—is the mohair which comes from the high lands in Asia Minor, but cases have also occurred in connection with similar wool from the Cape. That the dangerous parts of the wool are derived from the carcasses of animals which have died from disease is known from the condition in which the wool is found, portions of skin and blood being adherent to the fleece, sometimes the epidermis being found covering nearly the whole inner surface of the fleece. That the disease from which some, at least, of the animals have died is splenic fever is not only demonstrated by the effects of using the wool, but is known from the fact that this disease is widely prevalent, and sometimes occurs in severe epidemics in the districts from which the wool comes, and that all fleeces of animals dying from disease are indiscriminately collected and sold.

It is needful to insist upon these facts, seeing that in what follows the nature of the disease is a matter of considerable importance. But, without going further into the evidence on the subject, it may be stated as absolutely proved, that this wool or mohair is very largely infected with anthrax, and is capable of giving rise to the disease under suitable conditions both in man and animals. It must now be considered what were the special local conditions under which the proved transmission to animals occurred. In doing so, I desire to draw especial attention to three points—1st. The possibility of conveyance of the disease from parts of animals long dead to other animals, and its mode of transmission in such instances. 2nd. The evidence that the infected wool or hair is widely distributed in places where it is not being manufactured, and may be the unsuspected means of conveyance of the contagion. 3rd. The special conditions under which a test was afforded of the value of preventive inoculation of anthrax.

Outbreak of Splenic Fever on a Sewage Farm at Harden, traced to the conveyance of Infected Sewage-water in which Wool containing Anthrax Virus had been washed.

At a mill at Harden, near Bingley, where much mohair is used, often of the worst kinds, there had been several cases of wool-sorters' disease and of malignant pustule during the past year. The cases had occurred in batches in such a way as to show that there were some particular lots of wool specially infected. In November, 1879, two fatal cases and one non-fatal case had occurred; and there was then an interval of four months in which there were no cases. In the middle of April one case occurred, coincidently with the resumption of work on a particular lot of Van mohair. On April 23rd a case of malignant pustule occurred in a wool-sorter employed in the same mills, but this case recovered. On May 5th a fatal case of the "wool-sorters' disease" occurred in a wool-packer. All these men had been employed in sorting or packing the Van mohair of the same kind as that used in November. It appears, however, that only small lots of this wool had been in use, but on May 5th a large quantity was prepared for sorting, and twenty men were detailed for the work. They struck work, and refused to sort it until disinfected, and the employer at last consented to spread it out in a field to air; this was done from May 8th to May 10th, when the wool was sorted and washed in the usual manner. A few days later a cow died suddenly in the fields of a neighbouring proprietor, to whose fields the

sewage from the village is conducted, and the disease was believed by the veterinary surgeon to be splenic fever. During the month of June two sheep also died suddenly, it was believed from anthrax, but it was not until the end of June that further fatal cases appeared in cattle.

On June 30th, a cow which was grazing in the same field as the previous case was found dead, and a post-mortem examination was made twenty hours after death, which, together with subsequent microscopic examination and experiments by myself, proved the case to be one of anthrax in its most virulent form.

On July 4th another cow died, with similar evidence of death from anthrax.

On June 29th, a boy who was engaged in the mill, and was known to have come in contact with some of the wool which was being washed on June 23rd, was found to be seriously ill with malignant pustule.

The coincidence of the occurrence of these cases in cattle and the cases in the men employed at the mill, led to a more strict investigation of the precise local conditions, and to these we must now return. I shall briefly state all the most important facts observed on a personal inspection, as their comprehension is necessary for the proof of the case of carriage of the contagion by the sewage.

At the mills, which are situated nearly a mile from the farm, the wools used are almost solely mohair from Constantinople (chiefly "Van" mohair), and English wool. The sorting is conducted in a long room, where over thirty men are employed, and the wool is stored in bags along the side of the room. The sorting is done upon "tables" made of wire-netting, through which the dust and short hair fall into a receptacle beneath. From time to time these dust-bins beneath the tables are emptied, and the dust is mixed with night-soil, and used as manure on the farm connected with the mill. At other large mills this dust is sold for a similar purpose, and, as it contains a large quantity of animal matter, it is highly valued as manure. At the particular mill in question, large heaps of this dust lie about the yard until required for use.

The washing of the wool is conducted in a separate building, and is chiefly applied to the worst kinds of Van mohair. It is done by hand in long shallow troughs, into which hot water is poured by a pipe; but the temperature is probably never over 100° F. to 110° F.; viz. such a temperature as can readily be borne by the hand. Soap is used in this washing.

From the washing-trough all the water passes into two large vats or cisterns close by, which measure 15 feet by 20, and about 10 feet deep. In these vats the water is allowed to

collect until they are nearly full. Then, in order to extract the fat from the soap used, the liquor is "broken" by the addition of oil of vitriol, a quantity varying in amount but just sufficient to neutralise the alkali being used. The fat then separates and is skimmed off, and the remaining liquor is passed into the drain. It usually takes from two to three days to fill each vat, and another two or three to settle and "break" the liquor, so that each vat is only emptied once a week. This being done, all the contents of the vats pass into the common drain. It might appear that this was an unimportant part of the sewage; it is therefore necessary to state that, although there are a number of houses in the village, there is scarcely a single water-closet, all the night-soil being used for manure, and the surface-water going into other channels which flow to the watercourses. It thus comes to pass that by far the larger quantity of the drainage consists merely of the "sud-water" from the mills.

The drainage is carried some distance by means of earthenware pipes to near the bottom of a valley, but at a certain point iron pipes are substituted, as the farm lies higher than the bottom of the valley. In these the drainage is carried across a brook which courses down the valley. On reaching the highest point of the meadows irrigated by it, the drainage is received into two large cisterns, which are connected by valved outlets with pipes which open into one common outflow-pipe. From this the sewage outflow is directed down a narrow open channel cut in the earth along the brow of the hill, one side of which slopes downwards to the meadows, the other to the brook. All the sewage is carried off by lateral runnels or shallow trenches towards the meadows.

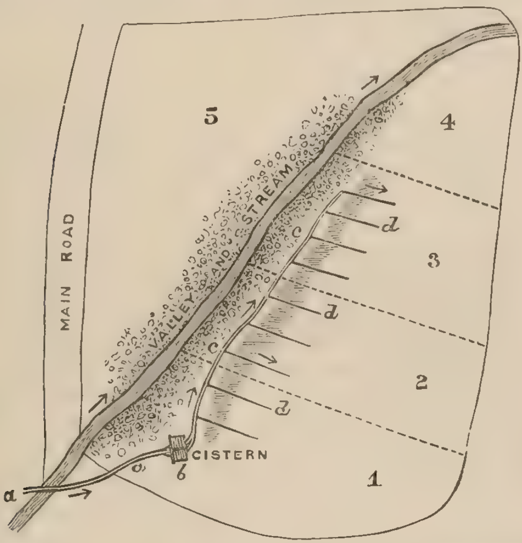
The better to explain the arrangement of the farm, the annexed rough diagram (p. 41) may be consulted. It will be seen that all the sewage is distributed on one set of fields, the others being separated by a deep valley, through which runs a rapid stream.

It will thus be seen that nearly all the sewage is distributed to the fields 1, 2, and 3, none to 4 and 5. The greatest accumulation takes place at the blind end of the final lateral channel, and here there is sometimes a considerable excess of overflow in wet weather. The other meadows, 4 and 5, are entirely devoid of sewage supply, and 5 is completely separated by the deep wooded valley and stream.

As regards the characters of the sewage, both in the cisterns and in the channels it exactly corresponds with that of the "sud-water" in the tanks at the mill. It has none of the ordinary appearance or odour of sewage, but is of whitish colour, and a peculiar soapy, oily smell. The deposit contains a large quantity of greasy matter and particles of hair, scarcely

any fæcal matter. That in the channels looks exactly like soapy water.

I have before stated that the meadows 1, 2 and 3, those in which this sewage-water is distributed, were the only ones in which cases of anthrax were known to occur, and it therefore became important to ascertain whether any other conditions existed which might have given rise to these cases. Without going into the details of this investigation, it may be stated that no such conditions could be discovered; the disease was



aa. Main sewer.
b. Cistern.
c. Main trench.
d. Lateral trenches with blind ends.

1, 2, and 3. Meadows in which the sewage is distributed.
4. Meadow beyond sewage.
5. Meadows on the other side of the valley and stream.

(The arrows show the direction of the flow.)

not known to exist anywhere in the neighbourhood, and all the other means of conveyance were exhaustively examined, with a negative result. The animals which died were buried in meadow No. 4, in which hardly any cattle were ever kept.

The marked coincidence of the occurrence of cases in the men employed on the wool, and in the cattle, tended also strongly to support this view of their common origin.

The proprietor of the farm bought 12 Scotch heifers in Mull in February; these were pastured together and fed on hay until the second week in May, when they were divided into three lots. The first lot of five were placed on the fields irrigated with the sud-water, viz. fields 1, 2 and 3. The second lot

of four were placed on the other field, 5. The third lot remained in the pasture they had been on from February. Lot I. —After three weeks on sewage-grass one was noticed to be slightly ill at night, and died at 8 A.M. on the following day. The remaining four were taken off this grass, three of them were slightly ill, two "scouring badly, one passing blood from the womb." After three or four days they were well. They were kept from the sewage fields a fortnight, then the four of Lot I. and the four of Lot II. were put together, and were on the sewage pastures 12 hours each day. In about 10 days, heifer No. 2 died, after 14 hours' apparent illness. This was the only remaining one of Lot I. which had not been ill. Heifer No. 3 was one of the second lot which had been on these fields 12 hours each day for about 10 days, and was not ill for $4\frac{1}{2}$ days after it had been removed from the second field. Lot III. remained perfectly well; they had not been on the sewage meadows. Another sheep died there of anthrax on July 30th.

These facts seem to require one or two words of explanation to bring out more clearly the inferences deduced from them. At first sight it does not clearly appear why only some of the animals were affected. Nor can it be seen why the sheep were affected in less proportion than the cattle. But certain facts must be borne in mind. The first is that the sheep in wet meadows rarely drink from running water, and as a matter of fact it was noticed that those sheep which cropped the thick grass at the edges of the runnels were those which died. Most of them would not take it there, but some seemed to have a preference for it. In the same way some of the cattle would not, especially at first, drink the water flowing in these channels, but after a time they grew accustomed to it, and took it in preference to other water. It is probably to this fact, as well as to the long intermission in the supply of the infected sewage, that the escape of the majority of Lot II. is due. A considerable interval was known to have elapsed, during which no washing of Van mohair was carried on, and the near coincidence of the recurrence to the use of that material, and the occurrence of cases in men and in cattle, is very striking.

On the other hand, if any other local cause of infection from previous cases had been operative, there can be little doubt that the mode of occurrence of the cases would have been very different; and there is thus a strong body of evidence that the disease was directly due to infection from the mohair.

To this farm three of the animals which had been inoculated, A, C, and D, were sent on July 14th, and placed at once on the fields in which the previous cases had occurred. They

remained there three months in perfect health, and are still (Dec. 1880) living and well. That the same causes were still in operation, is shown by the death of the sheep already mentioned on July 31st. Moreover, it was definitely ascertained that on July 22nd sud-water, in which Van mohair had been washed, was sent down—this, no doubt, leading to the death of the sheep on July 26th. On August 3rd another sheep was found dead, also from anthrax.

It is at least remarkable that these animals should be found capable of resisting the contagion for such a length of time, and it appears to me to be fully conclusive of the protective value of inoculation.

About ten days after the last heifer had been removed from the fields, having been upon them for four months, a cow, which had been placed upon the same field, died of anthrax under the following circumstances:—The proprietor had bought 11 Scotch heifers at the end of September, and kept them in the other fields not supplied with the sewage-water until November 23rd, when they were turned into the fields to which the sewage had been distributed. It must be added that, although some of the original sewage still remained in the cisterns, there had been no washing at the mill since the date above mentioned. On December 1 at 3 P.M., when the farm-bailiff went round, all the cattle appeared well, but on the 2nd at 8 A.M. he found one lying dead, apparently not having been dead long. Post-mortem and microscopical examination showed that the animal had died of splenic fever.

With regard to the possible spread of the disease by the washing of infected wool, another very closely analogous case, which came under observation about the same time, may be mentioned. The circumstances were very similar. Fatal cases of anthrax occurred in wool-sorters employed in a mill, and at the same time five cows on a sewage-farm which received the sewage from the mill died of splenic fever.

In reference to this subject it may also be mentioned that there is strong evidence that other materials capable of carrying the infection of splenic fever are sold for use in various ways in farms and elsewhere; the bags in which the wool has been kept are sold, and used as sacking or cloth. It is worth while to bear this in mind, in considering the origin of apparently spontaneous and isolated cases of splenic fever.

Few in number as have been the experiments made, owing to the costliness of the animals, and of their keep for a sufficient length of time to test the value of the inoculation, they afford sufficient evidence of its value as a preventive measure to encourage further investigation. This is especially desirable, as

since the publication of my first experiments the subject has been attracting much attention in France, and quite recently a number of experiments have been published which afford a striking confirmation of my own results. These experiments, to which I shall on a future occasion refer in fuller detail, have also shown that the effects are largely modified by the breed of cattle on which the experiments are made; in fact, that the relative susceptibility of various breeds is very various, so that in the practical application of any such method of preventive inoculation, what is good for French cattle does not necessarily hold good for English breeds.

III.—*Report of a Series of Outbreaks of Splenic Apoplexy on the Farm of Mr. J. R. Doggett, Holkham, Norfolk.* By J. Wortley Axe, Professor of Pathology at the Royal Veterinary College.

This Report refers to the prevalence of Splenic fever on certain marshes situated in the parish of Holkham, and now in the occupation of Mr. J. R. Doggett. The marshes in question form a part of the Earl of Leicester's estate. In consequence of a series of outbreaks of Anthrax among stock depastured there, I was requested, at the instigation of the Earl of Leicester, to visit Holkham, and institute a full inquiry into all the circumstances relating to the malady. At the same time many important facts concerning former outbreaks, as well as the more recent ones, were furnished to me by Mr. Shellabear, his Lordship's agent. These, together with others collected on the spot, form the basis of the conclusions arrived at with regard to the origin of the disease at Holkham. With a view to the furnishing of data for future guidance in elucidating the precise conditions under which "splenic fever" is developed, I have deemed it advisable to record such meteorological facts as I could gather in reference to the periods to which the several outbreaks refer. For information on this point I am indebted to the kindness of Mr. Shellabear, who has afforded me much valuable assistance in the course of the inquiry. I may remark here that three distinct outbreaks occurring at intervals of three years are concerned in this Report. In reference to the two first, the amount of evidence obtained is necessarily small, owing to the length of time which has passed since their occurrence. Having, however, been drawn, in great part, from Mr. Doggett's diary, the data are known to be precisely accurate, and therefore of considerable value to the inquiry.

TABLE I.—METEOROLOGICAL OBSERVATIONS, from 12th JUNE to 12th JULY, 1874.

Date.		Barometer.	Max. Therm.	Min. Therm.	Rainfall.
June	12	30·380	76·0	44·2	·0
,,	13	30·408	74·9	33·0	·0
,,	14	30·424	73·7	43·8	·0
,,	15	30·570	72·4	44·5	·0
,,	16	30·370	72·0	45·8	·09
,,	17	30·172	70·7	45·2	·02
,,	18	30·302	69·5	48·2	·0
,,	19	30·288	69·3	46·0	·0
,,	20	30·242	66·9	47·0	·0
,,	21	30·088	66·6	40·2	·0
,,	22	29·964	66·5	41·8	·0
,,	23	29·984	72·9	47·8	·08
,,	24	29·840	72·0	49·7	·15
,,	25	29·782	72·0	45·0	·26
,,	26	29·712	71·2	45·7	·17
,,	27	29·648	70·0	52·2	·0
,,	28	29·754	68·8	40·6	·0
,,	29	29·910	63·6	42·4	·0
,,	30	29·976	72·4	49·2	·10
July	1	29·964	73·0	56·8	·0
,,	2	29·902	75·7	53·0	·0
,,	3	29·953	85·5	54·4	·0
,,	4	30·002	84·7	50·2	·0
,,	5	30·198	82·7	47·0	·0
,,	6	30·356	81·2	40·5	·0
,,	7	30·218	80·4	46·6	·0
,,	8	30·140	80·0	43·5	·0
,,	9	30·144	79·4	54·2	·0
,,	10	30·140	81·4	53·8	·0
,,	11	30·052	81·0	50·0	·0
,,	12	30·040	80·4	55·2	·12

TABLE II.—METEOROLOGICAL OBSERVATIONS, from 19th MAY to 19th JUNE, 1877.

Date.		Barometer.	Max. Therm.	Min. Therm.	Rainfall.
May	19	29·788	62·7	..	·02
,,	20	30·068	58·6	..	·20
,,	21	30·170	54·0	..	·0
,,	22	30·244	51·7	..	·02
,,	23	30·208	50·2	..	·02
,,	24	30·206	54·7	..	·0
,,	25	30·214	54·8	..	·0
,,	26	30·164	60·2	..	·0
,,	27	29·824	65·6	..	·0
,,	28	29·170	65·6	..	·0
,,	29	29·472	65·2	..	·06
,,	30	29·574	63·8	..	·0
,,	31	29·632	64·5	..	·02
June	1	29·436	68·0	..	·09
,,	2	29·774	61·3	..	·03
,,	3	29·802	73·0	..	·0
,,	4	29·776	76·7	..	·0
,,	5	29·864	78·4	..	·03
,,	6	30·032	68·2	..	·0
,,	7	30·090	68·2	..	·10
,,	8	30·156	65·4	..	·0
,,	9	30·112	70·8	..	·0
,,	10	30·112	73·9	..	·0
,,	11	30·130	75·6	..	·0
,,	12	29·972	74·0	..	·0
,,	13	30·062	65·2	..	·03
,,	14	30·206	61·8	..	·0
,,	15	30·252	61·2	..	·0
,,	16	30·256	62·7	..	·0
,,	17	30·148	68·3	..	·0
,,	18	30·130	70·2	..	·0
,,	19	30·162	69·2	..	·0

TABLE III.—METEOROLOGICAL OBSERVATIONS, from 10th May to 10th JUNE, 1880.

Date.		Barometer.	Max. Therm.	Min. Therm.	Rainfall.
May	10	30·132	52·3	39·2	·06
,,	11	29·994	53·7	41·2	·22
,,	12	30·104	54·3	41·4	·0
,,	13	30·192	52·3	41·7	·0
,,	14	30·202	53·7	42·7	·0
,,	15	30·180	55·6	43·5	·0
,,	16	30·254	57·2	42·4	·0
,,	17	30·276	53·4	41·0	·0
,,	18	30·316	53·2	41·4	·0
,,	19	30·246	53·7	27·2	·0
,,	20	30·138	61·2	45·4	·08
,,	21	30·182	62·5	38·9	·0
,,	22	29·772	67·4	47·7	·0
,,	23	29·856	61·8	43·0	·02
,,	24	29·738	61·0	47·5	·03
,,	25	30·020	65·4	44·0	·05
,,	26	29·940	66·8	47·4	·0
,,	27	29·676	75·4	50·2	·14
,,	28	30·134	69·9	39·6	·03
,,	29	30·416	61·2	37·4	·03
,,	30	30·326	65·3	40·2	·0
,,	31	30·176	65·5	44·3	·0
June	1	30·232	58·4	43·2	·0
,,	2	30·138	56·5	46·4	·57
,,	3	29·942	54·7	47·3	·17
,,	4	29·866	53·4	44·4	·22
,,	5	29·924	55·5	40·2	·01
,,	6	29·790	60·0	47·0	·15
,,	7	29·546	63·2	43·7	·22
,,	8	29·724	56·2	40·8	·12
,,	9	29·790	58·2	37·7	·13
,,	10	29·842	60·8	39·4	·07

Outbreak of 1874.—The first of these outbreaks occurred in 1874, when 5 beasts, 4 horses, 3 pigs, and 7 sheep, succumbed to the effects of the disease, and several oxen had to be slaughtered while suffering under it. The malady first showed itself on the 12th of July, in one of several bullocks pastured on the marshes above referred to. These animals had received, besides grass, a liberal supply of linseed-cake daily. From a detailed inquiry as to the spread of the disorder on this occasion, there is little room to doubt that the great mortality which ensued upon the first cases was in no small measure due to the contamination of herbage, and other articles of diet, with the virus-laden excrement and blood of the animals in which the malady

TABLE showing the PROGRESS of the MALADY in 1874.

Date.	Description of Animal.	Age.	When Seized.	Disposal of Carcass.
July 12	Bullock ..	21 Months	Marsh N. of Decoy	Removal to farmstead.
,, 17	Brood Mare	6 Years ..	„ N.W. „	Some given to neighbours, other portions buried.
,, 20	Colt	..	„ N. „	
,, 20–25	Cow and 3 bullocks	..	Farmstead.	
,, 27	Colt	..	Marsh N. of Decoy	
,, 28	Bullock ..	..	„ „	
,, 30	Sow	..	Farmstead.	
Aug. 8	Cow ..	..	„	
,, 19	Boar.. ..	..	„	
,, 31	3 Sheep ..	..	Marshes.	
Sept. 4	Heifer ..	..	„	
,, 5	3 Sheep ..	..	„	
,, 21	Mare ..	..	Farmstead.	
,, 22	Calf	6 Months	Marshes.	

originated. This conclusion rests on the most satisfactory data. At an early period of the investigation it was elicited that the bullock which died on the 12th of July was dissected on the marshes. A portion of this animal was afterwards conveyed to the farmstead: some portions to be employed as food for pigs, and others converted into cart-grease. The farmstead is situated a considerable distance from the pasture in which the disease commenced, and besides pigs, it also contained at that time a number of beasts and horses. Between the farm-premises and the marshes no interchange of stock nor intercourse of any kind had taken place during the seven weeks which expired on the outbreak of the disease. Nor was there anything in common either in regard to food, management, or general conditions, between the home-stock and those at pasture

to which importance could be attached. It was not until the diseased flesh had been introduced upon the farmstead that any sickness was noticed there. Quickly following this event, however, several beasts became stricken with the disease, and were consequently destroyed; and, later on, two pigs also died from what was at the time regarded as quinsy, but which was no doubt acute splenic fever. From the 12th of July the disease continued to manifest itself, at shorter or longer intervals, up to the 22nd of September, as shown in the table annexed.

Outbreak of 1877.—Three years later, viz. 1877, anthrax again appeared on Mr. Doggett's marshes and destroyed, or caused to be destroyed, twelve beasts of various ages and several sheep. On this occasion the disorder was first seen on the 19th of June (three weeks earlier than before) in one of nine home-bred bullocks and heifers. This animal was at once slaughtered, and to prevent further loss the remaining eight were sold to a butcher. Immediately on the removal of the latter, fourteen older and poorer beasts were admitted to the same pasture. On the 28th of June one of these animals died, and was buried on the spot; and between that date and the 4th of July seven others had to be destroyed. The remaining six bullocks were now removed and replaced by sheep purchased to eat off the grass, but the same result quickly followed; several of the flock became infected and died in a few hours. The further mortality in respect of this outbreak is shown in the table annexed:—

TABLE showing the PROGRESS of the DISEASE in 1877.

Date.	Description of Animal.	Age.	Where Seized.	Disposal of Carcass.
June 19	Heifer ..	..	Decoy Marshes ..	
,, 28	Bullock ..	..	,, ,, ..	Buried on Marshes.
,, 28 to July 4	7 Bullocks	..	,, ,, (Destroyed) ..	
June 30	Bull and heifer ..	..	Marsh S. of Decoy	Bull buried on same Marsh.
July 2	Several sheep ..	..	Marshes.	

Outbreak of 1880.—The outbreak to which this Report more especially refers commenced on the 10th of June last. It appears that on the 13th of April Mr. Doggett purchased fifteen Shorthorn bullocks: they were low in condition, but nevertheless free from disease. Up to the 18th of May they were folded in a yard and fed exclusively on hay. From that time they were depas-

tured on Holkham Marshes during the day, and again folded at night, when the hay diet was continued. Of this hay Mr. Doggett says: "The hay that the bullocks have been eating was grown on the four marshes surrounding the Decoy in 1878. All the grass was mown about the same time, and with the view of improving the hay, some of the first cut was mixed in stacking with some of the last, as is our usual practice. All my stock of every description have been eating it during the past two winters without occasioning any sickness whatever." So far, therefore, as refers to this part of the food, any suspicion that might have attached to it may be safely set aside. On the 1st of June one of the fifteen beasts was noticed to be lame, and was consequently removed from the pasture and housed. It is worthy of note that notwithstanding the animal in question had fed on the marshes for fourteen days previously, he entirely escaped the sickness, while all the others excepting one are said to have been infected. On the morning of the 10th of June (nine days later) one of the remaining fourteen animals was found to be ill, and ultimately succumbed to the disease. Four days afterwards a second bullock died, and some others showed signs of the disorder. Ultimately all excepting one were more or less affected, and out of the fifteen only *four* survived. Between the 11th and 14th of June, while still suffering from the disorder, some of the bullocks were turned into a meadow adjoining the homestead, where several horses were at grass. On the 18th a bay cart-mare was stricken with the affection, and died within four hours. It may be mentioned as a remarkable coincidence that the dam of this mare died from the same disease in 1874, while the mare in question, then a foal, was suckling her. As in 1874 and 1877, so in 1880, the primary source of infection cannot be urged alone as the centre from which the more general outbreak sprung. It will be seen from what has already been stated that the ground had been overrun with the first fever-stricken beasts, and the herbage was consequently fouled with contaminated excrement, thus opening up a fresh and perhaps more generally diffused and virulent source of infection. In what relation these latter facts stand to others now to be stated it is difficult to determine, but it is worthy of remark that whereas an interval of several weeks elapsed in each outbreak between the stocking of the marshes and the commencement of the disease, a few hours, or at most days, only were needed to infect and kill both beasts and sheep subsequently placed on the pasture. As bearing upon the origin of these outbreaks, it may be important to notice that the variation in the time of their advent from year to year ranged from one to three weeks. Thus in 1874 the disease commenced on the 12th of July; in 1877 on the 19th of June;

and in 1880 on the 10th of June. To what special conditions this comparative uniformity in the recurrence of anthrax refers we have no sufficient data to show. Possibly in this direction meteorological science, aided by topographical considerations, may sooner or later afford us a clue to the solution of the question.

Topography.—The topographical circumstances of the marshes may be stated as follows:—Holkham marshes comprise a considerable area of low-lying land situated a few chains from the sea, between it and the northern boundary of Holkham Park. From the former they are separated by a range of sandhills, and from the latter by a high road from which the ground slopes down to the marshes. This flat extends east and west for some distance, and is said to have been reclaimed from the sea some 200 years ago. The soil consists of alluvium resting on a strong blue clay. The marsh is divided by large open drains into a number of fields of various sizes. The fields are in the occupation of several persons, chiefly farmers and graziers. In point of quality the pasture is considered of fair value for store grazing, but nowhere of such a class as to serve for fattening purposes. The open drains constitute the entire system by which the ground is relieved of superfluous water. The soil is habitually prone to supersaturation, and until 1876 was in a water-logged condition. This state was chiefly due to the soil-water being held up through the incapacity of the main drain to remove it. In consequence the produce of the land was seriously deteriorated both in quantity and quality. In 1876 the main drain was opened out, the general water-level then dropped 2 feet or more, and a corresponding beneficial effect accrued to the soil. Apart from the ordinary conditions as affecting the soil-water of these marshes, it should be pointed out that on the south side of the flat are several larger or smaller areas of spring bog, from which issues sufficient water to keep up a constant circulation throughout the entire area in question. Scattered over the marshes are numerous swampy spots covered with rushes and other semi-aquatic plants. To these swampy areas I shall have to refer again in considering the sources of the water supply. Of Mr. Doggett's marshes it may be said that in every respect, save one, the topographical characters are identical with those of other marshes adjoining. That one refers to the existence on the former, of a small shallow swampy basin, which originally contained water, and was used by Lord Leicester as a decoy for ducks, but which is now empty and overgrown with trees, and partly invested by rush beds. This decoy is encircled by four of Mr. Doggett's fields; to the south of, and contiguous with, which are others also in his occupation.

It is in the former of these pastures that the chief interest of this inquiry centres, inasmuch as on each occasion the malady has first appeared in one of them. All the cases having originated on those pastures which immediately surround the decoy, some suspicion was naturally excited as to the probable implication of the latter in determining the disorder. In this connection, however, it was elicited that at no time have cattle been known to enter the decoy; the fact of their having done so could hardly have escaped notice, inasmuch as it is surrounded on all sides by a considerable open drain, beyond which there grows a large quantity of brushwood, and in the decoy itself the trees are closely packed, and the branches low and spreading.

Prevalence of Anthrax.—In endeavouring to account for the origin of these several outbreaks and the peculiar localisation of the disorder, attention was first directed to a consideration of the prevailing diseases of the district. In this regard I had an opportunity of conferring with Mr. James Wright, Veterinary Surgeon, of Burnham, to whom I am indebted for much valuable information. This gentleman has conducted an extensive mixed practice in Norfolk for the past thirty years, and is well informed as to the nature and extent of prevailing diseases in the neighbourhood of Holkham. In this respect he assured me that splenic fever was of rare occurrence in the district, and both he, Mr. Doggett, and Mr. Shellabear agreed in the statement that, excepting on the four pastures immediately surrounding the decoy, anthrax had not been known to exist on any part of Holkham marshes, excepting in one instance, which was clearly an offshoot of the outbreak in 1874, and had been caused by the transference of diseased flesh from Mr. Doggett's farm on to one of his neighbour's.

Management of the Decoy Marshes.—In the circumstances of the four marshes contiguous with the decoy there is one feature in point of management that seems to me worthy of being recorded, and especially so since I am informed that it distinguishes them from all the others in Mr. Doggett's occupation, as well as from those in the occupation of other persons. It appears that the farm which Mr. Doggett now holds was for a long period prior to his tenancy in the occupation of his uncle, who adopted and carried on for many years a system of cake-feeding *on the four marshes in question*, and I understand that this practice has since been continued by Mr. Doggett himself. In what relation, if in any, this circumstance stands to the origin of the disease at Holkham I am not in a position to state. Past experience, however, has shown in numerous instances that land rich in the resources of vegetation is especially prone

to anthrax disorders, and markedly so under certain ill-defined climatic and topographical conditions.

Stocking of Decoy Pastures since the first Outbreak in 1874.— Since the first outbreak in 1874, the decoy pastures have been variously dealt with in regard to stocking.

In 1875, and again in 1876, they were fed with sheep, and during those years no disease appeared. In 1877 cattle were again turned on them, and again became the victims of anthrax. On this occasion the disease first appeared on the 19th of June, after which date the meadows were "shut up" and mown later on. In 1878 they were again mown, and eaten off with ewes in the autumn. In 1879 they were grazed with sheep without any ill consequences arising, and in 1880 cattle were again turned on to them, with the same unsatisfactory result as before. It will be seen from this that, in regard to cattle, the ground has proved fatal in every instance when they have been turned upon it since 1874; while sheep have on no occasion suffered, excepting when pastured with or following oxen in which the disorder existed. As previously stated, no anthrax disease is known to have occurred on the farm prior to 1874. The idea of a contaminated soil cannot, however, on that account alone be altogether dismissed from the inquiry. It must be kept in view that the seeds of anthrax, no less than those of wheat, enjoy a passive as well as an active state, and that in the one case, as in the other, certain favourable conditions are needed before the latter can be induced. In reference to those conditions it has been shown by Dr. Burdon Sanderson that certain articles of diet employed for feeding cattle furnish a fertile nidus in which anthrax organisms may propagate and develop. Thus grains have proved a most luxurious propagating medium, and among the various forms and conditions of vegetable matter contained in the soil, it is highly probable that other media may be found equally productive when acted upon by the combined influence of heat and moisture. It will appear, from what has just been remarked, that the absence of disease from a pasture, even for a long period, is not altogether inconsistent with the presence of the contagium in the soil. Whether the outbreak of 1873 was due to a recent importation of virus or to the accidental exhumation of long-buried anthrax matter it is impossible to state; but, having regard to all the facts of the case, the former conclusion appears to me to be the more acceptable.

Had the Water Supply any opportunity of becoming contaminated with the Virus of Anthrax.—It has been already pointed out that in 1874, and again in 1877, the carcasses of both oxen and horses were buried in the decoy marshes, and

in such a position as to render it quite possible for contamination of the general water supply to have occurred, and especially so under circumstances of a large effluent pressure of soil-water. That no such general pollution did occur is clearly shown by the absence of any epizootic tendency in the several outbreaks. From Mr. Doggett's marshes the stream flows in a westerly direction towards Wells harbour, and furnishes drinking-water to large herds of cattle, and other descriptions of stock, owned by various persons. Had the virus of anthrax been conveyed into any branch of the general water-service, the clearly defined and localised character of the outbreaks would have been impossible. A wide-spread epizootic must inevitably have arisen. The idea, then, of a pollution of the general water supply cannot be sustained. The only special source of water to which Mr. Doggett's cattle had access was furnished by the rush-beds referred to above. After a heavy rainfall they afforded a plentiful supply of stagnant water, and on them beasts would congregate during the warmer periods of the day, to shelter themselves from the heat of the sun and the irritating attacks of flies. The contamination of this water since the outbreak of 1877 is rendered probable in one instance by the proximity of a buried carcass; but this circumstance affords no explanation of the etiology of the affection on previous occasions.

Disposal of Diseased Flesh.—There is no etiological truth concerning which veterinarians are more agreed than that of the dissemination of *anthrax* by food and water contaminated with the excrement, blood, or flesh of diseased animals. I have already pointed out how largely excremental contamination contributed to swell the mortality at Holkham, and this inquiry would be far from complete if it left unnoticed the essential question of the disposal of diseased flesh. In this direction, then, I gathered that in 1874 some of the carcass of the infected mare was buried in the pasture south-west of the decoy, slightly removed from an open drain, and to this source the splenic-fever infection of 1877 and 1880 may possibly be referred; notwithstanding that the ground has not since been disturbed by spade or peck; for, according to the recent researches of Pasteur, the surface overlying a buried carcass may for a long period be fouled by the virus-laden soil of worm-casts, and even by tainted worms themselves. Besides portions of the mare above referred to, four beasts were also buried in the decoy meadows.

The probability of the disease having been contracted away from the marshes in 1877 and 1880 may, I think, be fairly dismissed on the following grounds:—

1. On being turned out, the cattle were perfectly healthy,

and their only movements afterwards were between the marshes and the homestead.

2. Several weeks elapsed between the depasturing and the appearance of the malady, while the incubative period of anthrax rarely exceeds three days.

3. There was no disease of this nature in the district.

The water and hay with which the infected animals were furnished were also being given to other stock on the farm.

So far as the circumstances of the two later outbreaks are known to me, there is no evidence whatever to suggest the recent importation of infection on to the ground.

After a careful review of the whole circumstances of this inquiry, I must confess my inability to arrive at any definite conclusion as to the mode of origin of the first outbreak of anthrax in 1874. Whatever may be the cause of the subsequent outbreaks, one thing is fully established, viz. that it must be sought for in some conditions peculiar to the four marshes specially referred to; outside which it was not operative in any part of the flat at any period. In this connection the circumstance of diseased carcasses being buried in the decoy pastures in 1874 and 1877 appears to stand out from all the others as best capable of explaining the chief facts developed in the inquiry. There is the strongest ground for believing that the outbreaks of 1877 and 1880 had their origin in fertile anthrax infection derived from these carcasses. How that matter was brought to the surface cannot be exactly stated. According to the recent researches of Pasteur, its exhumation by earthworms may be regarded as possible; of course, in this view of the matter, the question must arise—How is it, if the contagium thus exhumed was the cause of the outbreaks, that the disease did not manifest itself in adjoining pastures, having regard to the fact that the earthworms are migratory creatures, and that no obstacle to their passage from one field to another exists, and, moreover, that here, as elsewhere, no barrier to the dissemination of contaminated worm-casts, either as dust or otherwise, is presented. While admitting the possibility of earthworms as a factor in the etiology of anthrax, I think that a more consistent explanation of the facts developed in this inquiry may be found in the effluence of soil-water. By this means splenic-fever infection (where it exists) seems quite capable of being brought to the surface from underlying carnage. Subsequent exposure to heat and moisture in the presence of certain organic compounds would then seem to be all that is required to induce an active state and the necessary conditions of infection. The operations of moles and ants, and indeed of other agencies which we cannot precisely formulate, may on occasions also assist in this ex-

humation of the poison. The conclusions arrived at as to the origin of the disease in 1877 and 1880 would appear to suffer in some degree by the time which elapsed between the stocking of the marshes and the development of the fever. Such a delay, however, may be reasonably referred to the absence, during the interval, of those seasonable conditions on which the activity of germ-life so much depends. Moreover, past experiences have afforded me the strongest reasons for believing that an *anthrax diathesis* is, in some animals, an essential to primary natural infection. If such be the case, and the condition so expressed is, as it sometimes seems to be, intimately connected with a plethoric state, then the interval of time may be accepted as a necessary factor in the development of that state.

IV.—*Remarks on the recent Conference at Vienna on Agricultural and Forest Meteorology.* By R. H. Scott, M.A., F.R.S., Secretary of the Meteorological Office.

Were I to attempt to treat of the relations of meteorology to agriculture in any detail, the paper would stretch far beyond the limits available in the 'Journal,' for meteorology is so bound up with the science of agriculture that no farmer can dispense with some knowledge of its principles.

It is mainly the study of the climate of a country which determines the nature of the crops and the style of cultivation which will yield the best return for invested capital, and the study of climate is the most important branch of meteorological science.

The study of climate is, in one sense, only a form of weather prophecy. We determine by long-continued observation the average yearly and monthly figures for temperature, rainfall, &c. &c., and record the extreme variations from these figures which have been observed during the period of observation, and from these data we endeavour to calculate what temperatures, &c., may reasonably be expected to occur. For instance, as regards rainfall, engineers assume, as a rough-and-ready rule, for the greatest amount of rainfall likely to occur in a district, twice the quantity that has fallen in the driest year during the period of observation. This is simply to forecast climate; and the more extensive the basis of observation, the more trustworthy is the result.

Not only, however, is agriculture dependent on meteorology, but meteorology is in its turn dependent on agriculture, or at

least on the character of the vegetable covering of the soil, where such exists.

This latter branch of the inquiry is far more complicated than the former, and opinions differ widely as to the effect on the climate of a country which is produced by the presence, or the contrary, of woods.

The greatest difficulty we meet with is that, as the cutting of an extensive forest is not a rapid operation, the full result of the process on climate will only be manifest after a long lapse of years, when the clearing is complete. Now, the variations in meteorological values, especially in rainfall, from year to year, are not insignificant, and before we reason with confidence on the effect of woods on climate, we must satisfy ourselves and our readers that we really know what are the true features of the climate of the district in its wooded and its cleared conditions respectively.

Meteorologists and physical geographers are far too ready to make random assertions about the climate of foreign countries, and these are then quoted as if they possessed real value. Thus, for instance, in a very useful work on this subject of the influence of forests on climate,* the author says (p. 225): "In Ireland and Scotland, where the great woods, from which whole districts received their names, have disappeared, nevertheless the supply of water has not diminished:" we may fairly ask Prof. Ebermayer for any figures he may possess to show what was the rainfall of the British Isles three or four centuries ago!

Nay, in a work issued last year, which shall be nameless, although published under high foreign authority, we meet with the following astounding statement: "It is at least admitted that in the city of Manchester, since the multiplication of factories, hardly a day passes without rain." Taking one year as a specimen, the actual number of days with rain, with even as little as a hundredth of an inch, at Manchester, in 1878, was only 193, the average number for 33 stations situated over the United Kingdom, but mainly in England, being 199 in the same year, so that the mere presence of factories had not much influence!

To resume. The determination of the features of the climate of each district is a work demanding years upon years of careful observation, and for this reason, when the question is put to meteorologists—What will be the effect of planting on the water

* Ebermayer, '*Die physikalischen Einwirkungen des Waldes auf Luft und Boden und seine klimatologische und hygienische Bedeutung.*' (The physical action of forest on air and soil, and its climatological and hygienic importance.) Aschaffenberg: Krebs, 1873. 8vo.

supply of such and such a district?—the only answer an honest man can give is that he does not know.

Nevertheless, such questions as these are persistently pressed upon the notice of every meteorological official over the whole world; and on the continent of Europe, where agriculture and forestry are the especial care of the State, the complaint that meteorology does not help the farmers as much as she ought to do has been loudly and generally expressed.

The practical applications of the science are daily becoming more and more prominent, more especially with regard to weather forecasting; and accordingly, at the International Statistical Congress at Pesth, in 1876, the following resolutions were adopted:—

1. The Congress recommends to the Governments of all countries to institute special observations relative to agricultural meteorology, to be afterwards centralised, discussed, and regularly published by the Governments or scientific establishments.

2. The Congress requests the Governments to cause their agents (crop-reporters) to send to them monthly reports on the state of vegetation of the cereals in their districts.

3. The Congress recommends the Governments to institute observations with the object of ascertaining the influence on climate of the destruction of forests, and of planting trees.

4. The Congress expresses the wish that observations relating to thunderstorms, hail, as well as periodical phenomena respecting plants and animals, may be taken at the greatest possible number of points in each country, and that the results of these observations be centralised, co-ordinated, and published.

5. The Congress expresses the wish that a certain number of meteorological observatories should establish international telegraphic communications between themselves, in order to transmit to each other observations, with the view of the establishment of weather forecasts, for the benefit of agriculture and commerce. It requests that these observations may be, as far as possible, immediately brought to the knowledge of the crop-reporters and distributed among the public, especially with the object of preventing the effects of frosts, floods, &c.

The idea of an international exchange of crop-reports had been propounded at an earlier period by Maury, in an address to the National Agricultural Congress at St. Louis, May 1872, but his proposal was more in the interest of corn-merchants than of farmers.

The Pesth resolutions merely expressed a general desire that the subject of agricultural meteorology should receive attention, and they were accordingly brought before the Meteorological Congress in Rome at Easter, 1879, which included in its programme the following question:—

"How can the development of meteorology in connection with agriculture and forestry be forwarded by the Congress?"

The meteorologists present felt themselves incompetent to discuss this question fully, contenting themselves with laying down certain broad lines on which the subject should be treated, and recommending that a special Conference of experts should be convened to take it into consideration.

Such a meeting was accordingly held at Vienna in the month of September last, and was attended by 22 members, representing meteorology and agriculture in about equal proportions. Of these, Austria sent 8, France 3, Germany 5, and Hungary 2; while Belgium, Denmark, Italy, and Switzerland, sent one apiece. The only important meteorological organisations in Europe which were not represented at the Conference were Russia and this country, but in our case the Meteorological Society had taken the programme of subjects to be discussed into careful consideration, and had drawn up and forwarded a series of replies to the various questions therein contained.

The meeting was held in the Academy Building at Vienna, and it commenced on the 6th of September, lasting three days. The final outcome of the deliberations is conveyed in the subjoined resolutions.

At the outset it will be evident that the whole of the utterances presuppose the existence of a central agricultural institution connected with a Government department and administering extensive Crown lands. The considerations also have a closer relation to forest management than to simple agriculture, and accordingly several of the recommendations can scarcely be carried into effect in these islands.

With these few words of preface I shall proceed to the consideration of the Report, adding such explanatory remarks as may seem to be desirable, in view of the existing condition of the agricultural and meteorological organisations of the country. The questions of the programme will be given in italics, the resolutions between inverted commas.

Question I.

What are the mutual relations between the meteorological elements and vegetation: not only those already determined, but those theoretically supposed to exist?

R. 1. "Vegetation is materially dependent on the following meteorological elements:

a. "Temperature of the air and the soil.

b. "Duration and intensity of the light.

c. "All the hydrometeors; consequently the vapour tension and relative humidity; precipitation (rain and snow, &c.), as well as the other forms of condensation (fog, dew and hoarfrost).

d. "Motion of the air.

"On the other hand, the daily march of pressure and of ozone appear to exert but slight influence on the march of vegetation."

This resolution is self-evident, and the only remark which is called for is an explanation of the term Hydrometeors, which is employed in Germany to denote all the phenomena connected with the presence of water, in any form, in the atmosphere.

R. 2. "Conversely, the meteorological elements appear to exhibit the influence of vegetation in the following ways:

"Vegetation on a large scale (such as pasturage, tilled land, forests, moorland, &c.) gives rise, in each several district, to special conditions of temperature and atmospheric humidity, and perhaps of rain also, and may therefore exert an influence on the climate of the surrounding country in respect of temperature and hydrometeors, and also in respect of the springs."

This Resolution assumes the possibility of dealing with extensive tracts of country on similar principles, as will be seen further on, when we come to treat of the subject of Parallel and Radial Stations.

Question II.

To what observations of meteorological elements is particular attention to be paid with especial reference to their influence on vegetation?

R. 3. "On the whole, it appears important that, on as many rationally-managed estates as possible, special observations should be carried on of all the elements recognised as important.

"These observations should be made in different soils, and with different types of culture, and should be compared with the crop-returns, year by year, so as to investigate in detail the relation between the vegetation and the climatic factors.

"The general mean results published by the several central meteorological offices do not furnish values in sufficient detail for the study of individual types of culture, or of local conditions."

R. 4. "The Conference approves of Dr. Hann's proposal that the Governments and the agricultural societies be recommended to set on foot such organisations of stations for the study of agricultural meteorology as shall render it possible to ascertain the conditions of climate required by the most important crops, not only in the region where they reach their highest perfection, but also at the extreme limits of their cultivation."

It appears that the operations contemplated in these paragraphs are of such a nature as might be conducted in this country at large establishments dealing with extensive acreage. The experiments are such as have been conducted for many years with great success at Rothamsted.

With reference to the latter part of Resolution 3, it is universally admitted that the average results published in ordinary meteorological tables are not sufficiently detailed to throw light on the influence of weather upon agriculture, for the effect must vary with the nature of the soil, the lie and aspect of the land, and its height above the sea, and with the character of the cultivation employed. Moreover, the means should be published for shorter intervals than months, say for five-day periods, or even for single days.

The Meteorological Council, in their Weekly Weather Report, give means for weekly periods, but for large districts of country, so that, while these meet the demand of the Conference in one respect, they fail to do so in another—the giving of local details, except in the immediate vicinity of the stations.

R. 5. "It is recommended that comparative experiments should be conducted on the best modes of thermometer exposure. (A description of the modes of exposure adopted in different countries will be forwarded to the members of the Conference, as soon as the necessary particulars have been collected.)"

The subject of the best mode of thermometric exposure is one of those about which there exists at present the greatest difference of opinion amongst meteorologists, and it has been repeatedly proposed to publish such a general conspectus of the existing practices as to thermometer observations, but as yet the work has not been done. The method all but universally employed by the meteorological societies in the United Kingdom is to suspend the thermometers four feet above a grassplot, in a louvred wooden case like a small meat-safe—the screen devised by Mr. Thos. Stevenson, and named after him. This screen is intended to prevent any direct heat from the sun or radiation from the earth, &c., warming the thermometers, and on the other hand to cut off all radiation from the thermometers to surrounding objects. In the Glaisher screen, formerly much used at British stations, the thermometers were too freely exposed to the sky on the side away from the sun, and were therefore much affected by radiation.

The idea was, however, broached at the Conference that thermometers destined to give information for agricultural purposes should be freely exposed without any screen at all, inasmuch as plants can have no artificial protection against radiation. The President of the Conference, the Chevalier Lorenz von Liburnau, exhibited such an arrangement, and another came from Italy, devised by Professor Bellani, under the name of the Meteorological Mast, which is to be rigged up with the various instruments.

The idea has occasionally been tried in this country. At Yester House, Haddington, the Marquis of Tweeddale had for many years a set of self-recording instruments freely exposed to sun and rain in the middle of a large field. At Crowborough Beacon also, in Kent, Mr. C. L. Prince has made trial of a plan apparently similar to Prof. Bellani's, but no results have as yet been published.

R. 6. "As regards the hours for daily observation, the Conference is of opinion that when two observations only can be taken, it is preferable to take these in the morning and evening, with the indispensable addition of observations of maximum and minimum temperatures."

The Conference recognises the hours of observation in use in this country, 9 A.M. and 9 P.M., as sufficient, provided that observations of the maximum and minimum temperatures are made. These latter should always be taken at 9 P.M. Theoretically they should be observed at midnight, but the inconvenience of such a practice is fatal to its adoption, and so the nearest reasonable hour has been selected for the observation.

The old practice of reading both thermometers in the morning and putting down the maximum temperature to the preceding and the minimum to the current day must be abandoned, as it is illogical and may lead to error.

R. 7. "Insolation (or the sun's heat). As no thoroughly satisfactory actinometer is known, observations should in the first instance be taken only at large observatories, on the time, duration, and relative intensity of sunshine (the last-named by means of sensitised paper).

"It is recommended to scientific institutions as an important inquiry to devise an actinometer which shall be applicable to the sums of temperature derived from solar heat."

The correct measurement of the effect of sunshine is an extremely difficult problem to solve, for no instrument has yet been invented, or at least been generally adopted in any country, which gives the total useful effect of the sun's heat during a day. The ordinary observation taken, with the black-bulb thermometer *in vacuo*, is merely of the highest temperature reached in the sun's rays during the day; but this gives no idea of the length of time for which the sun has shone on that day, so that it in no way enables us to estimate the total useful effect of the sunshine. On the other hand, the sunshine recorders recently introduced in this country, and of which the results are printed in the Weekly Weather Report, give simply the epoch and duration of sunshine possessing sufficient power to scorch a blue card. The slightest film of cloud, barely perceptible to the eye, is sufficient to check the scorching entirely, but, once scorching is effected, there is no appreciable difference between the comparatively weak sunshine of a winter's day and the intense heat of an August afternoon. This instrument, therefore, fails to give us a quantitative measure of the heat received from the sun, and as it has only been in use for a little more than a year, no conclusions of much value have been drawn from its indications.

In connection with the subject of the registration of sunshine it may be interesting to quote the most recent determinations of the difference between the intensity of the sun's heat at different levels in the Alps :—

Locality.	Elevation.	Percentage of possible effect of Sun's rays actually received.
Summit of Mont Blanc ..	15,781	94
Grands Mulets	10,007	89
Glacier des Bossons	4,000	79
Grenoble	700	71

These figures show us that the lowest 15,000 feet of the earth's atmosphere absorb at midday one quarter of the useful heating effects of the sun's rays, and explain to us why the heat is found so oppressive in mountain ascents.

The expression "sums of temperature" calls for some explanation; in this resolution it evidently means the total amount of heat received during the day, but there is another use of the phrase, which was first employed by Boussingault, when he calculated the total amount of heat required to ripen various crops; stating, for instance, that wheat required 8248° Fahr., from the time it began to grow in spring, for the proper ripening of the seed. It is, however, as yet undecided whether this amount of heat is to be determined from the daily mean temperature or the daily maximum temperature, and on this point further investigation is desirable.

R. 8. "The temperature of the soil should be measured at least at four levels between the surface and the depth of one yard, and the experiments should be conducted in various soils, and with various kinds of crops, &c.

"This investigation most properly belongs to scientific agriculturists and forest officials, and to technical experimental stations."

Earth temperature is a subject to which too little attention has as yet been paid in England generally, but the Scottish Meteorological Society has for many years published such returns, and two very valuable and interesting papers from the pen of Mr. Buchan "On the Temperature of the Soil compared with that of the Air," have been printed in that Society's 'Journal' (vol. ii. p. 273, and iii. p. 211).

R. 9. "Observations on the occurrence of frosts are particularly desirable. The best mode of registering these observations in a form useful for practical discussions is a subject well worth study.

"Of course minimum thermometers are to be employed, but only such as have the bulb quite clear of the frame."

The registration of the occurrence of frosts hardly calls for remark, but there are several points of interest as to the limitation of the damage done to certain parts of a farm, such

as the hollows and bottoms, by the cold air flowing down into them, while the fields lying at higher levels escape injury.

A study of the alleged efficacy of smoke in checking the radiation and prevention of frost would be most valuable, and also of the benefits said to be derived from sweeping a rope over a field at sunrise, so as to brush off the hoarfrost before the sun shines on the leaves.

In connection with this action of frost a most remarkable experience of Mr. Buchan's deserves notice. It is given in the 'Journal of the Scottish Meteorological Society,' vol. iv. p. 147. In a nursery-garden a net had been stretched over one bed, out of four, of ash-seedlings. The net had holes in it, and was thrown back at one corner. The night was clear, with a very light breeze, and in the morning it was found that the plants covered by the net were damaged, while those in the uncovered part of the bed, even those opposite the holes in the net, had escaped. The destruction was greatest on the sides of the bed and in the furrows.

Mr. Buchan's explanation, which is evidently the true one, is that the net checked the motion of the air, and allowed radiation to exert its full effect. Over the uncovered plants the wind, though very light, removed the cold layer of air as fast as it was formed, so that the temperature never fell low enough to produce hoarfrost. In this case, therefore, the very device adopted to prevent injury from frost had aggravated the damage by interfering with the freedom of motion of the lower stratum of the air.

Thermometers for measuring the minimum temperature on the grass should be placed on props at about 2 inches from the soil, at the level of the tops of newly mown grass.

R. 10. "It seems most important that the relation between the radiation under a cloudless sky and the humidity of the atmosphere should be carefully studied at large observatories."

R. 11. "The methods of photometric observation, with especial reference to the chemical action of light, should be perfected by experiments at scientific institutions, in order to obtain a good chemico-photometric instrument."

The objects mentioned in these two resolutions stand in need of more careful investigation. As regards the action of light, no instrument as yet invented is either quite satisfactory in its results or easy of manipulation.

R. 12. "The humidity of the atmosphere should be measured by the dry- and wet-bulb hygrometer and the hair-hygrometer, and, if possible, three times daily (one observation being taken in the early afternoon).

"As to the apparatus to be used, the Conference recommends comparative observations with the complicated volume hygrometer of Schwackhöfer and the simpler apparatus of Edlmann of Munich, in order to determine which of these arrangements should be finally recommended for use in observatories.

"Ordinary stations should, for the present, employ only the dry- and wet-bulb hygrometer and the hair-hygrometer."

As regards hygrometry, or the determination of the amount of vapour in the air, the state of our knowledge is far from satisfactory; but, pending the result of such experiments as are indicated in the resolution, and are actually in progress in various laboratories, agriculturists must only content themselves with the dry- and wet-bulb hygrometer.

The old hair-hygrometer, though much in favour on the Continent for use in cold climates, is not so much needed in these islands, where the frost is not so intense or lasting as, for instance, in Central Europe, and the instrument is scarcely used here. Nevertheless the appliances for such an ordinary observation as that of the moisture in the air stand in urgent need of improvement.

R. 13. "The Conference is of opinion that observations on evaporation are important, but that no existing instrument can be proposed for general and exclusive use. In fact, it is recognised as an immediate requirement to devise satisfactory apparatus which will admit of the accurate measurement of evaporation, not only from open water-surfaces, but also from different soils in the fallow and cropped state.

"Meanwhile, observations on evaporation should not be omitted, but they should be conducted with simple forms of apparatus, especially such as depend on the principle of weight, as well as with Piche's evaporimeter, as proposed to be modified by Prof. Cantoni."

Evaporation is a subject which has not yet, in this country, attracted the attention it merits, for few points can be of greater importance to agriculturists than the removal of water from the soil, of which process evaporation is one of the channels.

The reason of our neglect of the observation is its inherent difficulty. No one can say that the evaporation from a dish of water placed on a grassplot gives a correct idea of the amount which would be removed in the same time from an equal area in the centre of a lake, while such an experiment can have next to no relation to the evaporation from the soil. This again varies largely with the character of the crop, as has been abundantly proved by the experiments at Rothamsted.

The form of apparatus recommended is of the nature of a balance, in one scale of which a pan either of water or of earth is placed, and its loss of weight in a given time ascertained.

Piche's small apparatus consists of a graduated test-tube filled with water and inverted, the mouth being closed by a disc of blotting-paper the size of a shilling, this latter is, therefore, the evaporating surface.

R. 14. "Condensation should be observed in all its forms."

R. 15. "The Conference thinks that observations on dew are important, but, in the absence of a thoroughly satisfactory apparatus, all that is required

is the careful entry of each occurrence of dew. It is recommended to conduct investigations for the purpose of devising a satisfactory dew gauge.

"As to fogs, the general rules proposed by the Vienna Meteorological Congress in 1873 should be followed."

The question of dew measurement is very interesting, but difficult. The total amount of moisture returned to the earth as dew has been estimated by Mr. G. Dines, F.M.S., as not above 1·5 inches annually.

The idea that the so-called dew-ponds are really filled by dew has been satisfactorily disposed of by Mr. H. P. Slade in his pamphlet on the subject, published by Spon in 1877.*

The only rule about the entry of fogs which was laid down by the Vienna Congress, is that fog should not be reported unless the observer was really enveloped in it.

R. 16. "The observations on rain, for objects connected with agricultural meteorology, should be conducted on the principles laid down by the Vienna Congress.

"It is very important for the purposes of agricultural meteorology that as large a number as possible of stations of a simple kind should be established, at which observations only of thunder-storms and of rain should be taken."

R. 17. "For the measurement of snow, gauges should be provided, which will prevent the danger of snow being blown out of the receivers."

It is hardly necessary to insist on the importance of rain observations in these islands, where the British rainfall system, under Mr. Symons, numbers some 2000 stations. As regards snow-gauges, the deep cylinders placed on top of the receiving-funnels of the gauge used by the Meteorological Office meet the requirements of the resolution.

R. 18. "Observations on the percolation and evaporation of the water in the soil should be introduced into the system of observations in connection with agricultural meteorology, but on no account are Lysimeters to be used.

"(The methods recently employed by Prof. Ebermayer in Bavaria have been described by him in an Appendix to the Report of the Conference)."

The Lysimeter consists of a metallic cylinder sunk in the ground and filled with earth. There is a double bottom, and a pipe leads from the apparatus to collect the water which percolates through the earth into the cylinder.

The section of the cylinder is one square foot, and it is made of various depths from one to four feet. The experience gained at the forest stations in Bavaria shows that the percolation determined by such a gauge is not correct. The earth at the bottom of the cylinder is always damper than the natural earth

* 'A small practical Treatise on Dew Ponds, the Farmer's Summer Water Supplies; being invaluable on hilly farms and sheep-runs, self-supporting, need no repair, and always efficient.' By Harry Pool Slade, Blewberton House, Aston, Wallingford, Berks. London: E. and F. N. Spon, 48, Charing-cross. 1877.

at a corresponding depth. This Professor Ebermayer explains by supposing that the moisture cannot escape laterally, as the metallic walls of the cylinder are impermeable. He also thinks the area of one square foot too small.

He has now introduced a plan somewhat resembling that devised by Mr. C. Greaves, C.E., for his experiments at Old Ford, the results of which he has described in his Paper printed in the 'Transactions of the Institute of Civil Engineers' (vol. xlv.).

He excavates in an artificial mound five chambers, each 3 ft. 3 in. deep, and 6 ft. 6 in. square. They are separated by walls of porous masonry 1 ft. 6 in. in thickness. The bottoms are conical, and tubes lead from them into a vault, where the receiving vessels are placed. These chambers are filled with the different kinds of soil, &c., which it is wished to subject to experiment.

Of course the arrangement can be used for other experiments, such as trying the temperature of the earth in various soils at various depths, &c. &c.

R. 19. "Observations on the direction and force of wind should be conducted in the same way as at the ordinary meteorological stations."

R. 20. "In order to investigate the climatic features by which masses of vegetation, such as wood, pasture, moorland, and heath, are distinguished on the one hand from each other, and on the other hand from bare earth, it is desirable to develop further the system of parallel stations, such as were established originally in Bavaria, and subsequently in other states of Germany and in Switzerland. It is also recommended to institute at the forest station of each such pair of parallel stations a new series of observations on the amount of water running down the tree-stems."

R. 21. "It is advisable to organise the system of radial stations, in order to ascertain the effect which extensive masses of vegetation, especially forests, exert on the climate of the surrounding region, both in the immediate vicinity and at a distance.

"This system promises the better results the more continental is the character of the region in which it is tried. In Central Europe, therefore, Eastern Germany comes first, then the Austrian Empire. When any new stations are established, especially radial stations, observations on the temperature and humidity immediately above the tree-crown appear to be of great importance."

The terms "parallel" and "radial" stations require some explanation, and it will be seen that the investigations of which the institution of such stations forms a part, belong in the first instance to forest meteorology, and are therefore of minor importance to agriculturists.

In the establishment of each station in the heart of a forest, care has been taken to provide a corresponding or parallel station in the open country adjacent, so as to eliminate any differences in the results which might be caused by differences in the situations of the stations, their distance from the sea, their elevation, &c., &c.

The organisation of radial stations has a wider scope, and is only suited for extensive forests, such as those in Eastern Europe. The principle is that a central station is taken in the middle of a large forest, and then, along lines lying north, east, south, and west from that point, pairs of parallel stations are to be established, so as to trace the gradual diminution of forest influence in different directions.

It is obvious that the maintenance of such a series of nine stations is only possible where the forests are in the hands of the State, and their management thoroughly centralised.

Question III.

To what extent and how can meteorological observatories and stations include special observations for the purposes of agricultural meteorology in the sphere of their operations, without hindrance to their activity in other directions?

R. 22. "In consideration of the requirements of agricultural meteorology which have been already enumerated, the Conference is of opinion that, at least in the larger States, and where distinct organisations for the purpose do not exist, central institutions of a special character should be established. The objects of such institutions should be to perfect the methods of observation, which are in many respects incomplete: to establish subordinate stations, or initiate their foundation: to support societies and private individuals in the foundation and management of such stations: to control their operations, and to collect and discuss their observations.

"Such special institutions should, however, always remain in connection with the general meteorological organisation of the country, in regard to the critical selection of methods of observation and of the publications."

This resolution also presupposes the existence of a powerful central scientific organisation, and any remarks to be made on this subject will more suitably be given further on.

Question IV.

Would it not be desirable, with a view to certain special observations which must be taken, such as, e.g., phenological observations, to prepare a general Form of Instructions?

R. 23. "The Conference thinks it advisable to entrust the preparation of general instructions for phenological observations to a special small Committee, consisting of three members. The preparation must be preceded by a careful examination and sifting of the Instructions already existing in most countries. The business of this Committee should be conducted by correspondence, and care must be taken that the observations do not embrace too long a list of plants. They should deal, firstly, with cereals and forage plants; secondly, with the more important forest- and fruit-trees; and lastly, with other plants of importance to agriculture, and with the phenomena of animal life."

The subject of what are called in Germany "phenological phenomena," the phenomena of the plant and animal worlds which are connected with the return of the seasons, have for a long time attracted attention in several European countries.

Most notably has this been the case in Belgium, where the famous statistician, the elder Quetelet, published his 'Instructions' in 1839, and where the results of these observations have now been published for forty years. In this country the matter has at various times been taken up, and at the meeting of the British Association at York in 1844 a Committee was appointed to lay down rules for the observation of these phenomena. The list of plants and animals proposed by this committee as subjects for observation was a very long one, and accordingly, when the matter was reconsidered in 1874 by a joint committee representing the Royal Agricultural, the Meteorological, and other societies, the list was greatly curtailed.

The reports of observations taken in accordance with these recent instructions have been published in the 'Quarterly Journal of the Meteorological Society' for the last six years, and they contain a rich storehouse of interesting facts, although we cannot say that as yet rules for the practical guidance of farmers have been laid down from the information collected, even in Belgium, where the system has been longest in operation.

Question V.

Can meteorological offices at present issue Weather Forecasts for the use of agriculturists with any prospect of success?

If the answer should be in the affirmative, how should the service be organised so as to attain this object as completely as possible?

R. 24. "The Conference is of opinion that, notwithstanding the existing difficulties of the subject, no meteorological organisation can decline to comply with the demand of the public for weather forecasts."

R. 25. "The Conference recommends the representatives of meteorology in different countries to prepare in their own languages, for the use of agriculturists, popular explanations of the principles on which these forecasts are framed."

One cannot but feel somewhat disappointed at these resolutions as conveying the opinions of men more than one of whom has for several years been entrusted with the duty of issuing daily forecasts for extensive areas. I had hoped that at least some estimate of the correctness of the forecasts issued in France and in Germany respectively would have been laid before the Conference. The latest tables of results published by our own Meteorological Office in its Annual Report were appended to the letter from the Meteorological Society, of which mention has already been made, and are reproduced in the lithographed Appendices to the Report, but no other office communicated even its own estimate of the value of its weather work. Especially interesting would it have been to have learnt the outcome of Leverrier's system of agricultural forecasts for France, the introduction of which was announced with a great

flourish of trumpets shortly before his death. This plan was devised to utilise local weather knowledge as much as possible. Public barometers were freely supplied to Communes, and daily summaries of the weather over Western Europe were sent gratis by telegraph. The authorities of the Commune were then required to appoint some official to prepare a forecast daily for the district by the use of the Paris telegram in addition to his own observations of local weather signs.

Such a system as this, only infinitely more completely developed, is in existence in the United States, where the weather service is a purely military organisation, and the amount of funds supplied by Congress is amply sufficient to defray the cost of its various developments, being on an immensely more liberal scale than has been dreamt of in any European country. Under this system, not only are competent officers placed at the different centres, and charged with the duty of publishing and issuing simultaneously the daily charts and forecasts of the service; but a frame, called the "Weather Case or Farmer's Weather Indicator" has been supplied for the last two years to a large number of stations. This contains a barometer and two thermometers—dry and wet—which are set every day at a regular hour. In addition, the frame not only shows what are the average values for pressure and temperature, &c., for the station for the month, and exhibits the latest telegrams received from Washington, but what is most remarkable in the way of utilising local signs of weather, it provides a disc to show what has been the character of the previous sunset.

A moment's reflection will show that it would be well-nigh impossible to introduce any such system in this country, from the lack of competent officials to manage the frames at the out-stations.

As far as I can gather, the experience of the foreign meteorologists is similar to our own, that a practised judge of local weather signs, such as the appearance of clouds, &c., when kept informed of the general conditions recently prevailing about him, as he may be by consulting the daily weather reports, or even the remarks in the daily press, can form for his own district a more useful estimate of weather than any which can be prepared by any Central Office.

The fact is that farmers expect meteorologists to be far more precise in their predictions than is at all possible. At a recent Agricultural Conference held in Germany, it was stated that forecasts ought to convey correct estimates of the amount of rain likely to fall on the days to which they refer; nay, more, that they should indicate which farms would be struck by hail. If meteorologists were only able to give such intimations as those

just named, their forecasts would deserve the title of prophecies instead of probabilities.

It may be of some interest to the readers of the 'Journal' to learn what has been the value of the forecasts issued by the Meteorological Office during the last two years. In order to put their system to a practical test, the Meteorological Council have in each of the years made proposals in the month of June to the Royal Agricultural Society, the Highland Society, and the Royal Dublin Society. The proposal was to send daily forecasts *gratis* during the hay-season to a number of observers selected by the Councils of the Societies, on two conditions: that the forecasts should be made known as widely as possible, and that a record should be kept of the value of each prediction.

The Council of the Royal Agricultural Society entered most cordially into the scheme, and the following list of recipients of the forecasts was ultimately prepared. The districts for which the forecasts are drawn up are eleven in number, being identical with those for which averages are given in the Weekly Weather Reports; and it will be seen that some of the districts are less completely represented than others; but this is unavoidable in making arrangements of such a novel character. In Ireland especially the number of stations was extremely small.

SCOTLAND, N.	Rev. Dr. Joass, Golspie. J. R. Mitchell, Drynie, Inverness.*
SCOTLAND, E.	J. Annand, Inverurie.* The Earl of Strathmore, Glamis by Forfar. W. S. McDonald, Craigielaw, Longniddry. C. S. France, Bank House, Penicuik.† J.M'Gregor, Ladywell, Dunkeld.† J. Fortune, Ratho.† W. Allan, Gogar, Edinburgh.† Rev. W. P. Robinson, D.D., Glenalmond.†
ENGLAND, N.E.	Jacob Wilson, Woodhorn Manor, Morpeth. J. Turner, Ulceby. W. Scarth, Raby Castle, Darlington.†
ENGLAND, E.	J. B. Lawes, F.R.S., Rothamsted. Messrs. Ransome and Sims, Ipswich.† D. M'Intosh, Havering Park, Romford.†
MIDLAND COUNTIES ..	W. T. Carrington, Croxden Abbey, Uttoxeter.* The Royal Agricultural College, Cirencester. The Duke of Somerset, Bulstrode, Bucks.* Major Dashwood, Kirtlington, Oxford.† R. R. Fowler, Prebendal Farm, Aylesbury.†
ENGLAND, S.	C. Whitehead, Barming House, Maidstone. E. P. Squarey, The Moot, Downton, Wilts.

* Those marked with an asterisk received the forecasts only in 1880; those marked with a dagger only in 1879. All the rest received them in both years.

SCOTLAND, W.	J. S. R. Ballingall, Eallabus House, Islay. C. H. H. Wilson, of Dalnair, Drymen Station, N.B.* J. Chisholm, Chapel Rossan, Stranraer.* Sir J. W. Orde, Bart., Auchnaba House, Lochgilphead.†
ENGLAND, N.W... ..	The Earl of Derby, Knowsley. G. W. Wray, Leyburn, Yorkshire. D. R. Davies, Agden Hall, Lymm, Warrington. A. Ashworth, Egerton Hall, Bolton-le-Moors.†
ENGLAND, S.W.	The Earl of Ducie, Tortworth Park, Gloucestershire. T. Dyke, Long Ashton, Clifton, Bristol. R. Neville, Butleigh Court, Glastonbury.
IRELAND, N.	J. Simson, Cloona Castle, Ballinrobe. Dr. Bentley, Oldcastle, Co. Meath.†
IRELAND, S...	D. A. Milward, New Ross.

Several of the recipients took great interest in the experiments, and in more than one case considerable trouble and expense were incurred by them to ensure the speedy dissemination of the intelligence. Of this some evidence is afforded by the following extract from a letter on the subject:

"The forecasts were despatched daily (Sunday excepted) from the London Office between 4 and 5 o'clock P.M. to our nearest post-office, distance about 3 miles from my residence, and they usually reached me about 5h. 45m. P.M. by a messenger who travelled on a velocipede. First, a copy of the telegram was retained and posted at the post-office (the place being a village with a considerable population), then over a district letter-box on the highway between two large towns, and at a meeting of cross roads 2½ miles from the receiving office. I had a small box with glass face, under lock and key, fixed over the letter-box, where the messenger deposited another copy of the telegram on his way here. This was again repeated 2 miles further on the same highway, and the meeting of cross roads in a village, over the letter-box there. A copy from here was again posted a mile off in another direction. By this means a tolerably wide circulation was obtained, most acceptable to my neighbours, and for which I was repeatedly thanked."

It is impossible for the Office to express too warmly its sense of the value of the co-operation and assistance it received, not only from the writer of the above letter, but from all those who undertook to conduct the experiment.

In analysing the numerical results, however, some difficulty

---

* Those marked with an asterisk received the forecasts only in 1880; those marked with a dagger only in 1879. All the rest received them in both years.

has been found, owing to the different estimates formed by different observers of what constitutes an accurate forecast. Of two recipients in the year 1880, situated in the same district, and under reasonably similar conditions of weather, one reported 30 per cent. of total failures, and 13 per cent. of entire successes. The other gave no total failures at all, and 48 per cent. of absolute successes! It is obvious that each of these estimates requires to be taken with reservation.

Summary of Results of Hay Harvest Forecasts in Percentages.

	Complete success.		Partial success.		Partial failure.		Complete failure.		Total success.	
	1879.	1880.	1879.	1880.	1879.	1880.	1879.	1880.	1879.	1880.
Scotland, N.	47	48	34	42	11	8	8	2	81	90
„ E.	44	52	31	29	16	16	9	3	75	81
England, N.E. ..	51	39	30	31	11	24	8	6	81	70
„ E.	47	44	23	40	20	12	10	4	70	84
Midland Counties	65	49	18	34	13	15	4	2	83	83
England, S.	55	32	33	41	12	22	0	5	88	73
Scotland, W.	44	31	23	37	14	18	19	14	67	68
England, N.W. ..	51	29	23	42	18	25	8	4	74	71
„ S.W. ..	51	42	21	44	17	11	11	3	72	86
Ireland, N.	43	17	37	39	9	39	11	5	80	56
„ S.	27	36	32	36	26	28	15	0	59	72
	48	38	28	38	15	20	9	4	76	76

The inspection of the table shows unexpected contrasts between the results for the two years. The only district for which the "total" figures are unchanged is that of the Midland Counties. The South of England shows a falling-off of 15 per cent. in 1880 as compared with 1879, while two districts adjacent to it indicate an improvement of 14 per cent. In the three last-named cases the reports have been furnished by the same gentlemen in both years.

The lowest figures in each year are for a district in Ireland. Mr. Milward, at New Ross, reports an improvement of 13 per cent. in 1880, while Mr. Simson, of Ballinrobe, only recognises 56 per cent. of success in 1880; being a falling off of 24 per cent. on the results for the previous year. These latter, however, were obtained from the average of two stations, one of

which was in the county of Meath, and therefore more advantageously situated (for the Office) than the west of Connaught.

The reader should be reminded that the Office expressly stated in 1879 that it did not feel confidence in its ability, with the means at present at its command, to issue forecasts of utility for the exposed Atlantic coasts of these islands.

All that can be said, therefore, is that the office is able to issue in the afternoon forecasts for the following day which are reasonably right in three cases out of four. The results of the forecasts issued to our continental neighbours in Germany by the office in Hamburg are somewhat higher, reaching a proportion of correctness of four out of five.

It must, however, be remembered that they enjoy the advantage of being covered on the westward by the British Isles, so that they get longer warning of changes coming on from the Atlantic than it is possible for us, in our exposed condition, to have.

As regards the latter of the two resolutions on p. 69 the desire that an authoritative manual of weather knowledge for popular use should be prepared is a very old one. In this country it was expressed by the Committee who reported to the Board of Trade on Admiral FitzRoy's work in 1866. Fourteen years after that date we find that no such book is in existence in this country, and it has hardly been thought of elsewhere! The fact is that the intrinsic difficulty of preparing a manual which shall assign due weight on the one hand to the ascertained relations of wind and weather to the distribution of pressure and temperature as shown by weather charts, and on the other to non-instrumental observations, such as the appearance of clouds, of the sky at sunset and sunrise, &c., is such as has hitherto deterred anyone from attempting the task. The manual recently published by the Meteorological Office, 'Aids to the Study and Forecast of Weather,' by the Rev. W. Clement Ley, is exceedingly useful for those who have some knowledge of the science of meteorology, but is hardly suited for the use of a beginner. My own little book, 'Weather Charts and Storm Warnings' (Kegan Paul and Co.), treats of the subject only with reference to the weather charts which appear in newspapers.

What is then the lesson to be learnt from the whole Conference? We have seen that there is hardly a single resolution which affords a definite answer to any of the questions of the programme, and the demand on all sides is for continued observations and investigations.

In this country any undertaking of regular observations must apparently be left to private enterprise, as there is no department of the Government within whose province it would fall;

but there seems to be no reason why the Council of the Royal Agricultural Society should not endeavour to enlist the services of several of its members in the cause.

England ought to be able to furnish replies to some at least of the numerous questions which are awaiting solution, as indicated in the preceding pages. If ever we are to have Government Agricultural Training Schools, these would be pre-eminently the stations where agricultural meteorology should be systematically studied.

There is little doubt that if application were made to the Meteorological Society, more than one of its Fellows would be found willing to co-operate in the work, for that society has of late selected local climatology as in a special way its line of attack in the prosecution of meteorological research.

These islands are too densely populated and too free from extensive forests for us to expect results of value from any forest stations; but with our humid climate, due to our oceanic position, the results obtainable with the various crops cannot fail to exhibit material differences from those derived from Continental experience, and to throw important light on the mutual relations between vegetation and meteorology.

V. — *Report on the Competition for Seed-Wheat*, 1880. By Wm. Carruthers, F.R.S., Consulting Botanist to the Society.

With the view of increasing the wheat-production of the country the Council resolved to direct the attention of seed-growers and agriculturists generally to the improvement of the varieties of wheat now in cultivation, and to the introduction of new and better varieties. It was resolved to offer two sets of prizes for distinctly new varieties of seed-corn which should combine the largest yield of grain and straw per acre with approved form and size, smooth and thin skin, full and white kernel, and high specific gravity in the seed, and with light, firm, and stiff straw. The history of each variety was to accompany the entry. The seed-corn for the one competition was to be delivered at the Society's Office before the 1st of October, 1879, and was to consist of a sack of grain and a bundle of straw. This competition would, it was hoped, bring to notice recent varieties which were yet in the hands of their producers. The entries for the second competition were deferred till October 1882, so as to give time

and opportunity for the production of new varieties by experiment or selection.

Six samples were delivered at the Society's Office by the time required for the first competition. Of these, four were white varieties, and two were red. In the terms of this competition it was stated that a portion of each of these samples was to be retained for comparison, and the remainder, divided into equal portions, was to be cultivated in 1880 in four localities differing in soil and climate, and the prizes were to be awarded to the varieties which gave the best results, if the Judges considered these varieties possessed qualities which entitled them to distinction.

The characteristics of the competing grains are described by their respective owners as follows :

No. 1 White Wheat was sent in by James Long, Henlow, Biggleswade, Bedfordshire, under the name "Selected Hardcastle." It was described as having a white and heavy grain, with a thin skin, a thick-set ear of medium length, and usually a rather short straw. It was selected from an old variety because of the fulness and largeness of the ear, and of its singular freedom from mildew.

No. 2 White Wheat was sent in by John Tuckey, Parsonage Farm, Goring, Oxfordshire, under the name "Webb's New Challenge White." It was described as having a very plump grain, a large ear, and long, stout straw. It was raised after careful and repeated selection, on the extensive seed-farm of Messrs. Webb at Windsor Hill, Staffordshire.

No. 3 White Wheat was sent in by Wm. Henry Mold, Bethersden, Ashford, Kent, under the name of "Mold's Ennobled White Wheat." It was described as having a medium-sized grain, with qualities commending it to the miller ; long and well-filled ears, and long and stiff straw, which stands well. Many years ago the competitor got the best white wheat he could and "ennobled" it until he got 105 heads from a single grain, some 8 inches long, and 131 grains in a head.

No. 4 White Wheat was sent in by Charles Shirreff Dods, of Haddington, under the name "Climax." It was described as having a longish, thin-skinned, and clear grain ; a long ear, rather wide between the notches, and a strong and bright yellow straw, somewhat darker toward the ears. It was raised from one grain, obtained in 1864, of a cross between "King Richard" and "Red Tuscany." "King Richard," the female parent, was raised by the late Patrick Shirreff by crossing "Shirreff's Bearded White" with "Talavera." In a letter Mr. Dods says that the whole stock sent was grown from one grain of 1875,

and that, considering the hybrid origin of the variety, it was probable that "sports" might appear in the crop. During the previous two years he had detected a few red-chaffed ears, but the grains in them were the same as the rest of the crop.

No. 1 Red Wheat was sent in by Wm. Henry Mold, of Bethersden, Ashford, Kent, under the name of "Mold's Ennobled Red Wheat." It was described as having a plump and round grain, with qualities commending it to the miller, a short and thick-set ear, and a short and very stiff straw of fine quality. It has been "ennobled" by the competitor during many years.

No. 2 Red Wheat was sent in by James Carter and Co., 237 High Holborn, London, under the name "Carter's Prize Selected Red Wheat." It was described as having a close-set, plump grain, a long and well-filled ear, and long and clean straw. It was raised from a seedling wheat selected by the competitors from a seedling raised by Mr. Wilkin.

The samples were carefully weighed and measured before they left the Office of the Society. The weight per bushel of the white wheats were as follows:—No. 1, $60\frac{1}{2}$ lbs.; No. 2, 58 lbs.; No. 3, $59\frac{1}{2}$ lbs.; No. 4, 56 lbs. And of the red wheats: No. 1, 58 lbs.; No. 2, 63 lbs.

It was decided to seek localities for the growth of the wheat in the North of England, in the Midland counties, and in the South. The hearty co-operation of the following gentlemen was secured:—Mr. James Edwards, of Woodhorn Grange, Newbiggin-by-the-Sea, Northumberland; Mr. Charles Randell, of Chadbury, Evesham, Worcestershire; and Mr. James Rawlence, of Bulbridge, Wilton, Wiltshire. The farm belonging to the Duke of Bedford at Woburn, and placed by his Grace at the service of the Royal Agricultural Society for experiments, was selected as the fourth locality, and one set of the samples was sent to the manager of the farm, Mr. W. J. Malden. These localities, it is believed, fairly represent, as far as four localities could represent, the different climatic conditions of the wheat-growing districts of England. The soils also were varied; for the field in Mr. Edwards' farm was a stiff boulder clay; that in Mr. Randell's farm was also a clay soil, but considerably more open, and in very good condition by cultivation; Mr. Rawlence planted the wheat on a very thin calcareous soil resting on chalk; while the farm at Woburn is a very light sand resting on sand.

After setting aside a peck of each sample for comparison, as had been arranged, the remainder was divided into four equal portions. As the weight of the sack of each variety was different, the weights of the quantities sent to the four growers varied, but each grower received precisely the same weight of each particular variety.

TABLE I.—QUANTITY of SEED SOWN and AREA of EXPERIMENTAL PLOTS, with DATES of SOWING.

WHITE WHEATS.

	1.				2.				3.				4.			
	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.
	lbs.	lbs.	rds. po.		lbs.	lbs.	rds. po.		lbs.	lbs.	rds. po.		lbs.	lbs.	rds. po.	
Mr. Rawlence	$56\frac{3}{4}$	$56\frac{3}{4}$	2 0	Oct. 24	55	55	2 0	Oct. 24	58	58	2 0	Oct. 24	$52\frac{1}{2}$	$52\frac{1}{2}$	2 0	Oct. 24
Mr. Randell ..	$56\frac{3}{4}$	36	2 0	,, 21	55	36	2 0	,, 21	58	35	2 0	,, 21	$52\frac{1}{2}$	35	2 0	,, 21
Mr. Malden ..	$56\frac{3}{4}$	$56\frac{3}{4}$	2 0	Nov. 11	55	55	2 0	Nov. 12	58	58	2 0	Nov. 10	$52\frac{1}{2}$	$52\frac{1}{2}$	2 0	Nov. 10
Mr. Edwards	$56\frac{3}{4}$	$56\frac{3}{4}$	2 9	,, 3	55	55	2 9	,, 3	58	58	2 9	,, 3	$52\frac{1}{2}$	$52\frac{1}{2}$	2 9	,, 3

RED WHEATS.

	1.				2.			
	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.	Quantity sent.	Quantity Sown.	Area of Land Sown.	Date of Sowing.
	lbs.	lbs.	roods po.		lbs.	lbs.	roods po.	
Mr. Rawlence	$56\frac{1}{2}$	$56\frac{1}{2}$	2 0	Oct. 24	60	60	2 0	Oct. 24
Mr. Randell	$56\frac{1}{2}$	35	2 0	,, 21	60	36	2 0	,, 21
Mr. Malden	$56\frac{1}{2}$	$56\frac{1}{2}$	2 0	Nov. 12	60	60	2 0	Nov. 11
Mr. Edwards	$56\frac{1}{2}$	$56\frac{1}{2}$	2 9	,, 3	60	60	2 9	,, 3

The whole of the samples were in the hands of the growers in the course of the month of October, 1879, and were sown within the next few weeks. The particulars of the weight sent, the quantity sown, the extent of the ground on which each variety was grown, and the date of the sowing, are given in the preceding Table (p. 78).

It is very important, not perhaps in relation to the competition for the prize, but in the interests of agriculturists, to observe that Mr. Randell sowed only about five-eighths of the seed he received on half an acre,* while the others sowed the whole of the seed they received, Messrs. Rawlence and Malden confining it to half an acre, and Mr. Edwards extending it to a little over half an acre. Mr. Randell saved a considerable quantity, and Mr. Edwards a lesser quantity, of seed-corn per acre as compared with the amount sown in the two other localities. The exact quantity saved per acre amounted in the case of Mr. Randell to 40 lbs. in No. 1 of the white wheats; 38 lbs. in No. 2; 46 lbs. in No. 3; and 34 lbs. in No. 4; and to 40 lbs. in No. 1 of the red wheats; and 48 lbs. in No. 2. In the case of Mr. Edwards, the saving amounted to 11 lbs. per acre in three of the samples, and to 12 lbs. in the other three. The saving effected by Mr. Randell is thus about 2 bushels in every 5 of seed-corn, a quantity so large as to form a very important consideration in economical farming. But such a saving cannot be effected in all cases, for while the sowing with sufficient space for the plants to tiller † suits the clay

* The remainder of the seed was drilled upon equal quantities of land on the 25th of November with the intention of carrying out a second trial, but all the plots suffered more or less from frost, and the trial was abandoned, the plots being harvested with the rest of the field.

† One of the most remarkable experiments carried out with the view of showing the extent to which a single wheat plant may produce secondary axes, that is, may tiller, was instituted by Charles Miller, the first Curator of Cambridge Botanic Gardens, and son of the distinguished Philip Miller, of Chelsea Gardens. He published an account of them in the 'Philosophical Transactions,' vol. lviii. (1769), pp. 203-6. On the 2nd of June, 1766, he planted some grains of red wheat. On the 8th of August one of the plants had tillered so much that he was able to divide it into eighteen plants. During the two following months these plants so established themselves and threw out secondary axes that he divided them, and planted out no less than sixty-seven plants, to stand through the winter. When the plants started into active life in spring they began again to tiller, and Miller in March and April so divided them that he produced in all five hundred independent plants. He believed that he could have made another division without interfering with the crop, and have increased the number to at least two thousand. But he allowed the five hundred plants, without further interference, to proceed to flower and fruit, and at harvest he had 21,109 ears, or an average of a little over forty-two ears to each plant. Some plants had more than one hundred ears. The ears were very fine, many of them measuring seven inches in length, and containing from sixty to seventy grains. The whole produce measured three pecks and three-quarters, and weighed forty-seven pounds seven

TABLE II.—YIELD in GRAIN and STRAW and VALUE of PRODUCE.

WHITE WHEATS.

	Grain.								Straw.				Total Value.		
	Weight.					Value.			Weight.	Value.					
	Per Bushel.		The Produce.												
	Best.	Tail.	Best.	Tail.	Total.										
	lbs.	lbs.	lbs.	lbs.	lbs.	£	s.	d.	lbs.	£	s.	d.	£	s.	d.
No. 1.															
Mr. Rawlence	60	47	1215	220	1435	7	1	8	1904	1	14	0	8	15	8
Mr. Randell ..	61	55	1143	167	1310	6	1	5	2912	2	12	0	8	13	5
Mr. Malden ..	59	53	533	20	553	2	11	4	1752	2	1	6	4	12	10
Mr. Edwards	62	51	560	87	647	3	7	0	1107	1	2	6	4	9	6
No. 2.															
Mr. Rawlence	61	56	823	362	1185	5	10	4	1568	1	8	0	6	18	4
Mr. Randell ..	62	58	1042	130	1172	5	14	5	2520	2	5	0	7	19	5
Mr. Malden ..	60	49	524	20	544	2	11	6	1793	2	2	6	4	14	0
Mr. Edwards	60	51	459	69	528	2	12	0	1128	0	18	0	3	10	0
No. 3.															
Mr. Rawlence	58	53	609	411	1020	4	3	9	1792	1	4	0	5	7	9
Mr. Randell ..	59	53	354	307	661	2	17	1	2408	2	3	0	5	0	1
Mr. Malden ..	57	50	400	22	422	1	18	9	1324	1	10	6	3	9	3
Mr. Edwards	62	57	812	123	935	4	18	11	1775	1	12	6	6	11	5
No. 4.															
Mr. Rawlence	55	42	440	177	617	2	8	6	672	0	7	6	2	16	0
Mr. Randell ..	57	48	862	184	1046	3	19	4	1904	1	14	0	5	13	4
Mr. Malden ..	54	47	136	19	155	0	12	3	648	0	15	0	1	7	3
Mr. Edwards	61	53	797	113	910	4	12	0	1573	1	10	0	6	2	0
RED WHEATS.															
No. 1.															
Mr. Rawlence	61	52	976	81	1057	4	16	8	1456	0	19	6	5	16	2
Mr. Randell ..	60	51	1211	107	1318	5	17	8	2072	1	17	0	7	14	8
Mr. Malden ..	59	49	621	32	653	2	16	3	1771	2	2	0	4	18	3
Mr. Edwards	62	57	993	137	1130	5	12	7	1961	2	10	0	8	2	7
No. 2.															
Mr. Rawlence	61	48	976	323	1299	5	16	3	1456	0	19	6	6	15	9
Mr. Randell ..	61	56	1423	84	1507	6	15	5	2520	2	5	0	9	0	5
Mr. Malden ..	59	44	613	16	629	2	16	3	1917	2	4	4	5	0	7
Mr. Edwards	61	53	561	61	622	3	0	6	1162	1	0	0	4	0	6

soil of Chadbury, it would have been most baneful on the chalky soil at Bulbridge. The chalk on which the thin covering of soil rests is as effectual a natural drain as a subsoil of pure sand would be. To prevent evaporation as much as possible, Mr. Rawlence resorts to thick sowing, and before the sun has attained strength sufficient to dry up the surface-soil, his wheat-fields are covered by a thick crop of green. This he could not secure were he to trust to the tillering of the young plants.

The earlier part of the season of 1880 was a singularly good wheat season, and the promise of the experimental crops, like that of the wheat crops of the country, was very encouraging. But at the time when the ears were filling, a period of rainy weather produced a condition of the atmosphere specially fitted for the development of parasitical fungi. Mildew attacked all the crops, and prevented the complete filling of the grains by arresting the elaborated juices of the plant on their way to the ears, and utilising them for their own growth. The result was that just before harvest, when there was the prospect of a heavy yield, the mildew destroyed these hopes by giving a larger percentage of imperfectly filled grains, and so greatly increasing the amount of the seconds in the produce of the crops. Although growing on so dry a soil, the crops grown by Mr. Rawlence suffered most; but for this the produce of his cultivation would have shown a much more favourable result.

The crops were cut down during the month of August. The results of the cultivation will be best seen by an examination of the preceding Tables.

The estimates of the value of the grain and straw were supplied by the growers, and represent the local opinion of the market value. This is obviously a fairer basis than by treating the whole at the prices of a particular market, although it necessarily introduces a different standard for each of the four localities.

The real issues of the trial as an agricultural experiment will be perhaps more apparent if we consider what the produce of grain and straw would be per acre at the rate of the produce of the portions of an acre given in those Tables. In placing these calculations before the reader, I have inserted in the first column the total amount of grain produced in each plot, and arranged the details of each kind of wheat in the order of the amount of produce :—

---

ounces. The grains were estimated to have numbered 576,840. The ground on which Mr. Miller conducted his experiment was a light blackish soil on a gravelly bottom. One half of the ground was very much dunged; the other half was without any manure. No difference was however observed either in the living plants or in their produce, though thus differently treated.

Table III.—Showing the Produce of Wheat and Straw per Acre.

No. 1 White Wheat.

	Total Weight of Grain.	Rate per Acre.			
		Grain.	Straw.		
	Lbs.	Bushels.	Tons.	Cwts.	Qrs.
Mr. Rawlence	1435	50	1	14	0
" Randell	1310	43½	2	12	0
" Edwards	647	20	0	19	1
" Malden	553	19	1	11	1

No. 2 White Wheat.

Mr. Rawlence	1185	40	1	8	0
" Randell	1172	38	2	5	0
" Malden	544	18½	1	12	0
" Edwards	528	16½	0	18	0

No. 3 White Wheat.

Mr. Rawlence	1020	36	1	12	0
" Edwards	935	28½	1	8	2
" Randell	661	23½	2	3	0
" Malden	422	15	1	2	0

No. 4 White Wheat.

Mr. Randell	1046	38	1	14	0
" Edwards	910	27½	0	16	2
" Rawlence	617	24½	0	12	0
" Malden	155	6	0	11	2

No. 1 Red Wheat.

Mr. Randell	1318	44½	1	17	0
" Edwards	1130	35	1	11	2
" Rawlence	1057	34	1	6	0
" Malden	653	22½	1	11	2

No. 2 Red Wheat.

Mr. Randell	1507	49½	2	5	0
" Rawlence	1299	45½	1	6	0
" Malden	629	21½	1	14	1
" Edwards	622	19½	0	18	3

It is apparent that in none of the localities was there an exceptionally large yield of grain and straw per acre from any of these competing wheats. This Table shows that the thin sowing adopted by Mr. Randell secured on the same extent of land as heavy crops as were obtained by the thicker sowing in the other localities; while at the same time it justifies the opposite method employed by Mr. Rawlence to overcome the difficulties he has to contend with in cultivating his thin chalky soil.

The small crop on the Woburn farm is due to some extent to the poor character of the land, but chiefly to the early attacks of mildew on all the crops. The grain produced, however, was of good quality, and when the seconds were separated the best consisted of well-filled, well-formed, and good-coloured grains. No. 4 white wheat came up very thinly; a large proportion of this grain did not germinate at Woburn.

Messrs. Edwards and Randell have supplied the means of comparing the results of their cultivation of the competing varieties with their ordinary crops.

Comparison of Mr. Edwards' Ordinary Crops with the Competition Samples.

White Wheats.

	lbs.
No. 1	647
„ 2	528
„ 3	935
„ 4	910
Ordinary crop	779

Red Wheats.

	lbs.
No. 1	1130
„ 2	622
Ordinary crop	1071

Comparison of Mr. Randell's Ordinary Crop of White Wheat with the Competition White Wheats.

	lbs.
No. 1	1435
„ 2	1172
„ 3	661
„ 4	1046
Ordinary crop	1440

It is important to notice that notwithstanding the attack of the mildew the produce of the year's growth was generally

equal to the sample sent in, as determined by the weight per bushel, as will be seen by the following Table :—

TABLE IV.—WEIGHT per BUSHEL of the BEST.

	White Wheats.				Red Wheats.	
	1.	2.	3.	4.	1.	2.
Original sample ..	60½	58	59½	56	58	63
Mr. Rawlence ..	60	61	58	55	61	61
„ Randell	61	62	58¾	57½	60½	61
„ Malden	59	60¼	57½	56	59⅓	59⅓
„ Edwards ..	62	60	62½	61	62½	61

The heaviest crops, judged by the standard of this Table, were those of Mr. Edwards; but at harvest they suffered from rain, which considerably reduced the market value; besides, the whole bulk was short of the crops in other localities.

The Judges appointed by the Council, with Mr. Charles Whitehead, Chairman of the Seeds and Plants Diseases Committee, as Steward, selected No. 1 White Wheat as being first in order of merit, and No. 1 Red Wheat as second, and No. 2 White Wheat as deserving special commendation.

The prizes were offered for distinctly new varieties, but the Judges declined to declare that the samples on which they had adjudicated were entitled to be considered new varieties. The characters presented by the samples of straw and grain submitted to them were not, in their judgment, sufficient to justify them in arriving at a positive decision. Thus the question as to whether the specimens decided to merit the prizes, by their intrinsic qualities, were new varieties, was left to be investigated by the Committee on Seeds and Plant-Diseases.

With the view of obtaining materials for their guidance in dealing with this matter, the owners of the three samples selected by the Judges were requested to supply more specific information in regard to the history and peculiarities of the grain they had sent in for competition.

Mr. Tuckey, the owner of No. 2 White Wheat, wrote that his wheat had been imported by Messrs. Webb and Sons, and that it had taken several first prizes when shown by them, and that Mr. Tuckey had himself taken some cups by it. In the judgment of the Committee this information excluded it from competition on the published terms.

Mr. Long, in his original entry, had described his grain as having been obtained by selection from Hardcastle, and as being distinguished from that old variety by its large and full ear. While there was no difference of opinion as to the quality of the grain, neither of the Judges nor the members of the Committee were able to discover any points in the straw or grain by which they could distinguish them from good specimens of ordinary Hardcastle. In answer to further enquiries, Mr. Long informed the Committee that, having observed a few fine ears of white wheat growing in a field of Red Browick, he carefully preserved and cultivated them, and the sample submitted for competition was from the produce of these ears. As his account of the origin of the grain, which, differing somewhat from the account given in the entry, failed to supply any characters on which the Committee could distinguish the sample from the well-known Hardcastle, they could not declare it to be a new variety, and they accordingly resolved to recommend the Council to withhold the prize.

The Messrs. Carter and Co., adhering to the description given in their entry, did not succeed in convincing the Committee that their sample was a new variety, and the name given to it of "Carter's Prize Selected Red Wheat" was believed to imply that it had already been exhibited, and been rewarded. Under these circumstances the Committee held that this red wheat must be considered disqualified to receive the prize, and they recommended accordingly.

The Council adopted the Committee's recommendations, and the decision was published, and communicated to the parties concerned.

Further communications were forwarded to the Committee both by Mr. Long and Messrs. Carter and Co., in which were given at greater length and with more precision the history of their respective wheats. The Committee expected to have been supplied with such information at an earlier stage in their investigation. However, although the matter had naturally ended with the Council's resolution in accordance with the Committee's recommendation, the Committee gave full consideration to these communications. The result was that, while they were satisfied that these competitors believed their samples were new varieties, they had failed to obtain distinctive characters which would justify the Committee departing from the well-considered judgment to which they had previously come—that the samples could not be considered as new varieties of grain. Looking, however, at the quality of the samples grown, and at the testimony of the Judges, the Committee resolved to recommend the Council to give to Mr. Long and to Messrs.

Carter and Co. silver medals, as a permanent record of the superiority of the produce yielded by their samples. This recommendation was adopted by the Council, and the medals have been presented.

VI.—*Practical Experience in the Manufacture and Use of Malt for Feeding Purposes.* By Frederic Beard, of Horton, near Canterbury; with a Note by James Howard, M.P., Clapham Park, Bedford.

Directly the Excise restrictions were removed, I resolved to malt for feeding purposes a considerable proportion of my large crop of inferior and second-rate quality of barley.

Having hop-oasts with kilns, I decided to use one of them for the purpose of drying the grain.

The kiln is about 14 feet square, with open fires under a horsehair cloth, and with a tall narrow roof surmounted by a cowl, such as many of the readers of the 'Journal' of the Society may probably have seen when passing through the hop-growing districts of Kent.

The lower or ground floor of the oast-house is, in my case, asphalted, but any floor that will keep the corn clean during the process of malting will answer the purpose. I may perhaps say, that not having had any previous experience in malting, I made some few enquiries of those who had; the result being that I found the process a very simple and easy one, and instructed one of my farm labourers how to carry it out, thus: I put 40 bushels of barley into two tubs fitted with perforated boards so as to allow a space of about 3 inches between them and the bottom of the tubs; sufficient water was then added to wet the barley thoroughly, the surplus water passing through it to the space between the boards and the bottom of the tubs, and when the barley was sufficiently soaked the water was drawn off by taps.

At about the end of forty-eight hours the barley was taken from the tubs, and spread on the floor to the depth of 8 or 9 inches. After lying so for another forty-eight hours it was moved forward towards the drying-kiln to make room for the next lot, and again moved in the same direction for another lot, until I had three or four different wettings on the floor. By that time the first wetting should be nearly or quite fit to go on the kiln, the test that I have used being the sprouting of the barley to about half the length of the grain. When the barley is on the floor

during the latter part of the process it should not exceed 6 inches in depth, and should be kept constantly turned to prevent undue fermentation, and the rootlets of the grain from becoming matted together. The process altogether occupied on an average twelve days, but the time it takes is of course somewhat dependent on the temperature of the weather. I found a reduction of nearly 20 per cent. in the weight of the grain by the process, the bulk remaining about the same. I paid 1*s.* 6*d.* per quarter of 8 imperial bushels for the labour, and burnt not quite 2 cwt. of best malting coal for drying each 5 quarters of barley, the value of which is 2*s.* 3*d.*, making the total cost of manufacture, exclusive of the use of oast, rather less than 2*s.* per quarter.

The grain was kept on the kiln at least thirty-six hours, at a temperature on the oast-hair not exceeding 100° Fahrenheit, being kept thus low for fear of injuring the hair-cloth; but notwithstanding this, I found the drying sufficiently good for feeding purposes, and that the malt will keep good for two or three months. My mode of using the malt for cattle is as follows: I grind it into meal, mix it with straw cavings and inferior hay cut into chaff, and a sufficient proportion of pulped roots to ferment the heap properly in twenty-four hours, by which time the mixture is fit for use, and is then fed in the usual way. I allow 1 gallon of malt-meal for each animal, and all have as much of the mixture as they will eat. The fatting cattle have linseed-cake and barley-meal in addition. I find the food thus treated is consumed very greedily, and, apart from any advantage in malt over barley as cattle food, I think its value as a condiment quite pays for the cost of conversion. I also use the malt for sheep and horses, and for their use pass it through an ordinary oat-crusher. The mixture used for sheep in the folds is malt, barley, and linseed-cake in nearly equal proportions; and for horses, malt, barley, and oats, with the addition of bran equal in bulk to the whole of the other three articles.

I commenced using malt in the foregoing way in the third week in October, and have seen no reason to alter my original plan of manufacture or feeding. All the animals are healthy and thriving. I have made a very considerable saving in my outlay for purchased foods, and have, I believe, fed my stock cheaper and better than I could have done in any other way.

My barley has usually been grown of a good quality, and nearly all of it sold to the maltsters, but last season was an exceptional one throughout the district, the crop, though large in quantity, having been of an inferior quality, and consequently difficult to sell. If some such plan as mine were generally adopted, inferior and second-class barleys would be removed

from competition with the best, the consequent enhanced price of the latter, coupled with the benefit the growers would get from feeding their own produce in the shape of malt, would enable barley-growing farmers in some degree to meet the difficulty of carrying on their business in these hard times without positive loss.

On this subject the following letter has been addressed to the Secretary by Mr. James Howard, M.P.:—

"In answer to your inquiry about malt, I regret I cannot furnish any comparative results between this and other feeding stuffs. For many years I have used malt for getting horses into condition with the best results. Since the repeal of the tax it has become upon my farms an article of regular diet. Each working horse has weekly 1½ bushel of oats, 1 peck of maize, a peck of malt, and 14 lbs. of bran, the maize and malt being crushed and mixed together; malt does not do without crushing. Our horses have done better on this allowance than they did when fed upon 2 bushels of oats, half a bushel of maize, and 14 lbs. bran; there is, moreover, an appreciable saving in the cost of keep. Young growing horses, not yet in the team, have 1½ lb. malt per day, in addition to 3 pecks of oats and 14 lbs. of bran per week. Wether sheep on roots have half a lb. each per day in addition to half a pint of maize and 1 pint of tail-barley. The housed sheep have, per score, 2 bushels of malt and 2 bushels of maize weekly, besides linseed and cotton-cake, changing the maize occasionally for white peas and old beans. I have not yet given malt to ewes, but intend to commence its use when the lambs are about a month old.* Our feeding bullocks have 2½ lbs. (increased to 4 lbs. as they reach maturity) of malt per day, mixed with 1 gallon of meal and 1 gallon of linseed and cotton-cake. Our young horned stock have about half a lb. each of malt, with a pound of cotton-cake per day. I find it desirable to proceed tentatively, commencing with small quantities, and increasing the quantity as I find it suits the animals. I am satisfied with the results, and am convinced that malt will become an article of regular diet upon stock farms. My bailiff formerly managed a farm for a Maltster, and had considerable experience in its use before the tax was repealed, he entertains a high opinion of its value if judiciously used.—*Clapham Park, Bedfordshire, Feb.* 7, 1881."

* Since this letter was written I have commenced to give malt to the lambs. Three hundred lambs have, per week, 2 bushels malt, 2 bushels maize, 2 bushels white peas, all crushed and mixed with 1 cwt. bran. The lambs are doing well.

VII.—*Remedy for Foot-and-Mouth Disease.* By Sir E. C. Kerrison, Bart., Oakley Park, Scole, Norfolk.

In these days of severe agricultural depression, when it is difficult for skilful farmers to make both ends meet, their misfortunes have been increased by the continued prevalence of foot-and-mouth disease—newly infected districts being almost weekly proclaimed by the Privy Council—making the sale and transmission of cattle more than ordinarily difficult; and there is no doubt that it is only by the most stringent measures that the disease can be stamped out. This is no new disease; it has been known for many years; but large cattle-markets, easier communication by rail, and frequent sales, have caused it to spread with unusual rapidity. Cargoes of foreign cattle, carelessly inspected on landing, have been known by one consignment to disseminate disease over a whole district. At the Royal Agricultural Show at Battersea, some nineteen years ago, I was one of the Judges of foreign cattle, some of which were affected by foot-and-mouth disease. Three days after a change of wind, which carried the disease from the foreign cattle to the English, a number of the animals at the Show were affected. Several of these animals on removal either died, being in first-class condition, or were seriously damaged. My own prize animals were much reduced in value by it, and a prize Suffolk bull, the best I ever possessed, had to be killed, as he never could stand on his feet afterwards. Pailfuls of the usual drinks and drenches were given to these animals without effect. Much the same treatment is now still resorted to by veterinary surgeons in the country. Some farmers give drinks from receipts twenty or thirty years old, others rub the noses of the animals with salt, whilst a good many let Nature take its course, and the disease gradually dies out. In all these cases, if there is no real loss of cattle, there is an immense loss of condition, from 5*s.* to 1*l.* a-head. In cow-stock sometimes half their value is sacrificed. The milk falls off; when they calve they are unable to bring up the calf; and sometimes one or more of the quarters of the cow's udder becomes permanently damaged. Sows die, and almost invariably the pigs lately born also die. For all these ailments veterinary science has up to now discovered no speedy cure. Reading in the 'Times' some six weeks ago that by the use of salicylic acid in Silesia and other parts of the Continent, this disease was speedily arrested, I purchased a quantity in case of accident. Salicylic acid has been for some time in use in our hospitals as a quick and speedy remedy for rheumatic fever,

inducing free perspiration, and very soon giving ease to the patient. I had often thought that foot-and-mouth disease generated and spread more rapidly in low lands or where animals were exposed by rail or otherwise to sudden changes of temperature. I had my reasons, therefore, for believing that this acid must be a valuable medicine in cases of feverish symptoms in animals. About the 7th of December last I purchased seven lean bullocks which had been in the possession of the owner for a fortnight, and had been passed as sound by the veterinary inspector. They were put into a meadow with sheds, completely separate from all other cattle, where they remained till the 7th of January. They were then removed by private roads to a farm where there were fifty-three head of cattle, free from disease, besides pigs. On the 10th of January four of these bullocks were pronounced to have foot-and-mouth disease. One had a very swollen tongue, and was very ill. I ordered at once the following remedy to be used, and that one man alone who did not go near the other animals should attend them.

Receipt.—Pour some hot water on about three tablespoonfuls of salicylic acid in an earthen vessel, adding lukewarm water to make up a gallon. The mouth and feet of the diseased animal should be carefully washed three times a day with this liquid, and the tops of the hoofs well powdered after each ablution. Also dissolve two table-spoonfuls of the acid in hot water, and add it to the drinking-water of the animals. The sheds must be kept quite clean, and all dung must be saturated with the acid to prevent further infection.

The fourth day these bullocks began to eat, and by the 15th the whole seven were chewing their cud as usual. Since that time a month has elapsed, and although they have been supplied only with their usual food, they have increased in value from 6*s.* to 7*s.* a-head. On the 15th the wind changed to the east, and carried the infection to twenty-three calves 50 yards distant in a covered yard. Now, said the local veterinary surgeon, these calves will die like flies. I certainly had misgivings about two puny calves which I always thought would die a natural death without disease, but the whole twenty-three have recovered, the disease in every case lasting only four days. The calves are now kicking and jumping in excellent health, and one would suppose from their appearance that spring was shortly approaching, but for the terrible weather. When the wind turned to the south twelve cows became affected, ten in-milk. All these have recovered, five days being the longest period any of them were ill. They have hardly wasted at all in their milk, and I expect that on the 8th or 10th day from their infection they will be pronounced sufficiently sound for their milk to be used. A sow

was then seized with the complaint. The veterinary inspector advised my at once killing the young pigs, as they would surely die; indeed such has been the case in my neighbourhood under the old treatment. It is rather a difficult operation to smear the pig's snout. She was, therefore, only given water impregnated with the acid. In two days she was perfectly cured, and her five pigs are quite well, and will, no doubt, live to accomplish the aim and object of a pig's life—to get fat in the shortest possible time. Up to this date forty-three head of stock have had it for an average time of about four and a half days each. The animals that were attacked have nearly all gained in condition, and really the only loss has been that of the milk for a few days, but I have no veterinary bill to pay. I recollect some years ago fourteen bullocks being attacked with pleuro-pneumonia on a neighbouring farm. The farmer employed two veterinary surgeons, one a homœopath, the other an allopath. I asked him which practitioner he preferred: he said he scarcely knew what answer to give, for all the bullocks had died; but he preferred, upon the whole, the allopath, for he could see the thick drinks he gave, whilst the homœopathic medicine was not discernible. I think my practical experience will show that many thousands of gallons of drinks now used may be superseded by the use of salicylic acid, and in the course of a very few days animals may be restored, and even improved in health, by the use of salicylic acid. In order to spread this far and wide, having once been President of the Royal Agricultural Society, I have taken advantage of the kindness of the Editor of its 'Journal' to give through its medium the earliest intelligence of this German discovery.

It is difficult to obtain an accurate account of the many thousands of animals throughout England now suffering from foot-and-mouth disease. In this county, the highest return for one week has been 4722 head. One hundred and twenty-three animals have died—all of which, in my opinion, would have recovered had the remedy given to them been salicylic acid.

Since this fresh outbreak of foot-and-mouth disease, which began on the 2nd of October, and the accounts of which are made up to the 5th of February, no less than 2704 farms in Great Britain have been declared infected, 103,607 animals have been attacked, and on the 5th of February 39,765 animals remained under treatment. The County Returns, at any rate those in Suffolk, are so badly drawn out that I cannot tell how many animals have been affected in this county. There must be a considerable number of deaths throughout England, but it is rather to the loss of condition than to the number of deaths that we must look; and we should welcome any new medicine

which may, like salicylic acid, reduce the number of days of suffering and loss of condition of the animals.

Since the first few lines of this Paper were written the disease has disappeared from my farm, and every animal is in better health than before. The cow which had the disease the worst is now giving more milk than before she was attacked. I have also tried an experiment with salicylic acid on sheep with foot-rot of so bad a kind that their hoofs came off, and have found that they recover more quickly when that medicine is applied to them than from any other foot-rot remedy I had previously tried.

The great importance of this discovery cannot be over-estimated when some 40,000 animals are known to be suffering at this moment from foot-and-mouth disease, and the trade in cattle and sheep in several counties has been almost entirely stopped, and that at a time when graziers in the corn-growing counties have the greatest number of cattle to dispose of. Salicylic acid can be procured from any chemist at the cost of 1*s.* an ounce, or less if a larger quantity is required.

VIII.—*Field Experiments on Swedish Turnips with Soluble and finely ground Phosphatic fertilisers.* By Dr. AUGUSTUS VOELCKER., F.R.S., Consulting Chemist to the Royal Agricultural Society.

BY the liberality of His Grace the Duke of Bedford, a field well adapted for experiments was recently placed at the disposal of the Royal Agricultural Society for the more special purpose of testing experimentally, on a sufficiently extended scale, the comparative manuring properties of finely ground coprolites and other mineral phosphates and phosphatic fertilisers, in which the phosphates for the greater part are actually soluble in water.

The field, which was very foul, was steam-cultivated early in spring, and an enormous quantity of weeds brought to the surface when the steam-harrows were put through the land in April. The steam-harrows did excellent work. The most level, and, as far as could be judged, the most uniform part of Warren-field was set apart for the swede-experiments. This part of Warren-field was divided into 24 sections, of one-fourth of an acre each.

The whole of the 6 acres occupying the 24 experimental quarter-acres was surrounded by a path $2\frac{1}{2}$ feet wide, and each

quarter-acre separated from the adjoining one by a path 2½ feet in width.

The land was bouted up on the 5th of May, horse-hoed on the 17th of May, ploughed back May 18th, horse-hoed June 21st, and set out June 23rd, 1880. It was then in a fairly clean condition, but brought to light afterwards a great many surface-weeds, which were kept under by horse- and hand-hoeing as well as the wet weather in July would permit.

The soil of the experimental swede-field is much stronger, and contains more clay than Stack-yard field, upon which the experiments upon the continuous growth of wheat and barley, and the rotation-experiments, have been in progress for the last four years.

The surface soil, to the depth of 18 inches, contains a fair admixture of sharp sand and clay; it may be briefly described as a rather strong turnip-loam. It rests on a reddish coloured, and in places dark coloured, retentive clay subsoil.

A preliminary examination showed that the soil contains about 1 per cent. of carbonate of lime, and an appreciable amount of phosphoric acid and potash. I am at present occupied with careful detailed analyses of a number of samples taken in Warren-field at different depths, at places upon which none of the manures used were put. On a future occasion I hope to report the results of these soil-analyses, and also upon the composition and nutritive value of the swede-crops grown on the various experimental plots.

The primary object of the experiments was to test the effects of finely-ground coprolites, and of superphosphate made by treating coprolites with sulphuric acid.

At the same time it was considered desirable to try experimentally the fertilising properties of ground raw bones and dissolved bones, and also the effects of precipitated phosphate of lime—a commercial material which is obtained as a by-product in the manufacture of glue from bones, and which may be regarded as the mineral portion of bones, in a chemically divided or precipitated form. In this condition, the mineral portion of bone, consisting mainly of tribasic phosphate of lime, is infinitely more bulky and more minutely divided than bone-ash, ground into the most impalpable powder.

Redonda phosphate, a mineral consisting of hydrated phosphate of alumina and iron, and unsuitable for the manufacture of superphosphate, or similar artificial manures, in a finely ground condition, has been recommended as a manure from time to time, but I am not aware that it has ever been tried in exact field-experiments. Last spring, Redonda phosphate was offered for sale at 2*l.* to 2*l.* 5*s.* a ton, and, on account of its cheap-

ness, it struck me as being well worth a trial, in comparison with the experiments on the more expensive coprolite powder.

As the soil contained only about 1 per cent. of carbonate of lime, and as chalk, in many instances, has a good effect upon root-crops, and was procurable in the neighbourhood of Woburn at a cheap rate, a moderate dressing of chalk was put upon two of the quarter-acre plots. In making field-trials exclusively with phosphatic fertilisers, it may be maintained with some reason that the more or less complete failures with a purely phosphatic manure do not necessarily prove its inefficacy, for inasmuch as such a manure supplies only phosphoric acid and lime, or merely two constituents of plant-food, it cannot possibly produce a healthy and abundant crop of swedes or other roots if the requisite amounts of potash, sulphuric acid, magnesia, and other mineral or ash-constituents of roots, and the needful proportions of organic nitrogenous plant-food for securing a good crop, do not occur in the land upon which the experiments are made. Thus, for instance, I showed, years ago, by actual field-experiments, that whereas superphosphate alone, applied to certain light soils, or potash alone, had comparatively little effect upon clover, the two united together produced a very satisfactory increase.

As Warren-field possibly might have been deficient in one or more of the essential elements of plant-food, it appeared to me advisable to manure some of the quarter-acre plots with well-rotted dung, a perfect manure, which supplies all the organic and mineral constituents which are required for the healthy and vigorous growth of any kind of agricultural produce.

As a heavy dressing of dung per acre is expensive, and even the best rotten dung contains but a small proportion of phosphoric acid, it occurred to me to experiment upon the effects of a comparatively moderate dressing of rotten dung, supplemented by phosphoric fertilisers. Accordingly, quarter-acre plots were set aside, upon which half a dressing of dung and ground coprolites were put, and others upon which dissolved coprolites were put in addition to the same amount of dung.

Two of the 24 quarter-acre plots were left unmanured, and thus furnished experimental evidence of the root-growing powers of the land in 1880, unaided by farmyard-manure or any artificial fertiliser. In field-experiments extending over a number of years, which I conducted at the Royal Agricultural College, Cirencester, and elsewhere, I generally found a mixture of superphosphate and Peruvian guano one of the best artificial manures that can be applied to light and loamy soils or moderately strong land, as a manure for root-crops. Although a mixture of superphosphate and Peruvian guano may not appear

suitable in the series of experiments which I devised, with the primary object in view of obtaining information upon the comparative fertilising effects of finely ground and of soluble phosphatic manures, I thought it might be interesting, from a purely economical point of view, to test the effects of a guano and superphosphate mixture, costing less than one-half of the expense of a dressing of 20 tons of dung; and accordingly I preserved two plots for trial with guano and superphosphate.

The dung was applied to the land in a rotten state, between the 13th and the 15th of May, and the artificial manures on the 10th of May, 1880.

The swedes (Gibbs Selected) were sown on the 24th of May, in rows 22 inches apart.

The following table shows the way in which the several quarter-acre plots were treated as regards manure, the cost of each kind of manure per ton, and the cost of the application per acre.

Plots.	Manures Used.	Quantity of Manure per Acre.	Cost of Manure per Ton.	Cost of Manure per Acre.
			£ s.	s. d.
1	Finely ground coprolites	6½ cwts.	3 10	22 9
2	Dissolved coprolites	5 cwts.	4 10	22 6
3	Finely ground Redonda phosphate	10 cwts.	2 2	21 0
4	Dissolved bone-meal	3½ cwts.	6 10	22 9
5	Precipitated phosphate	4½ cwts.	5 0	22 6
6	No manure	..	..	..
7	Raw bone-meal	3 cwts.	7 10	22 6
8	Rotten dung	20 tons.		
9	Rotten dung	10 tons.		
	and dissolved coprolites ..	5 cwts.		
10	Rotten dung	20 tons.		
	and finely ground coprolites ..	6½ cwts.		
11	Chalk	5 tons.	About 5s.	25 0
12	Dissolved coprolites	3 cwts.	4 10	13*s.* 6*d.* } 44*s.* 9*d.*
	and Peruvian guano	2½ cwts.	12 10	31*s.* 3*d.*

These experiments were made in duplicates.

It will be seen that, with the exception of the manures applied to plot 12, the cost of the artificials per acre was very nearly the same in all cases in which artificial manures were used.

The following sketch shows the arrangement of the 6-acre field:—

WOBURN ROOT EXPERIMENTS IN 1880.

CROP SWEDISH TURNIPS (GIBBS Selected PURPLE), each PLOT $\frac{1}{4}$ of an ACRE separated from the rest by PATHS $2\frac{1}{2}$ feet in width.

No. 12 A.	3 cwts. of dissolved coprolites, and $2\frac{1}{2}$ cwts. of Peruvian guano per acre: cost, 44*s*. 9*d*. per acre.	No. 6 B.	No manure.
No. 11 A.	Chalk 5 tons per acre: cost, 25*s*. per acre.	No. 5 B.	$4\frac{1}{2}$ cwts. precipitated phosphate per acre; cost, 22*s*. 6*d*. per acre.
No. 10 A.	Dung 10 tons and $6\frac{1}{2}$ cwts. of ground coprolites per acre.	No. 4 B.	$3\frac{1}{2}$ cwts. of dissolved bone-meal per acre; cost, 22*s*. 9*d*. per acre.
No. 9 A.	Dung 10 tons and 5 cwts. of dissolved coprolites per acre.	No. 3 B.	10 cwts. of Redonda phosphate per acre; cost, 21*s*. per acre.
No. 8 A.	Dung 20 tons per acre.	No. 2 B.	5 cwts. of dissolved coprolites per acre; cost, 22*s*. 6*d*. per acre.
No. 7 A.	3 cwts. of bone-meal per acre: cost, 22*s*. 6*d*. per acre.	No. 1 B.	$6\frac{1}{2}$ cwts. raw coprolites per acre; cost, 22*s*. 9*d*. per acre.
No. 6 A.	No manure.	No. 12 B.	3 cwts. of dissolved coprolites and $2\frac{1}{2}$ cwts. of Peruvian guano per acre; cost, 44*s*. 9*d*. per acre.
No. 5 A.	$4\frac{1}{2}$ cwts. precipitated phosphate per acre: cost, 22*s*. 6*d*. per acre.	No. 11 B.	Chalk 5 tons.
No. 4 A.	$3\frac{1}{2}$ cwts. dissolved bone-meal per acre; cost, 22*s*. 9*d*. per acre.	No. 10 B.	Dung 10 tons and $6\frac{1}{2}$ cwts. raw coprolites per acre.
No. 3 A.	10 cwts. Redonda phosphate per acre; cost, 21*s*. per acre.	No. 9 B.	Dung 10 tons and 5 cwts. of dissolved coprolites per acre.
No. 2 A.	5 cwts. dissolved coprolites per acre: cost, 22*s*. 6*d*. per acre.	No. 8 B.	Dung 20 tons per acre.
No. 1 A.	$6\frac{1}{2}$ cwts. ground coprolites per acre: cost, 22*s*. 9*d*. per acre.	No. 7 B.	3 cwts. bone-meal per acre: cost, 22*s*. 6*d*. per acre.

On each quarter-acre plot there were 30 rows, 22 inches from row to row.

The seed was sown on the 24th of May, and on the 7th of June, when I inspected the field, it had come up sufficiently well on all the plots to show the rows in the field.

On the 18th of June, the plants on the unmanured plots were decidedly behind the others, and on the 6th of July the difference in the growth of the seedling swedes was still more marked on the unmanured plots.

On the chalk plots the swedes were a little more forward than on the unmanured plots, but not much.

The swedes on the two plots manured with dissolved coprolites were decidedly in advance of those grown on the plots manured with ground coprolites.

Similar differences were noticeable on the plots manured with raw and dissolved bone-meal.

The swedes dressed with precipitated phosphates looked quite as well, if not better than, those manured with dissolved coprolites. As far as appearances went, the swedes manured with guano and superphosphate showed best in the field on the 6th of July; next followed those on the precipitated phosphate plots, then the dissolved coprolite plots, next dung and dissolved coprolites; then the Redonda phosphate, followed by the dung and raw coprolite plots. Next in order were the plots manured with the large dressing of dung, and last stood the bone-meal and the ground coprolite plots, which were about equal.

On the 24th of July I took the following notes in the field:—

The swedes had made great progress on all the experimental plots. On all, the plant was very regular.

The unmanured plots were much behind the others, but the swedes looked healthy and growing.

The plots manured with chalk were scarcely better than the unmanured swedes.

The most forward plots were those manured with dissolved coprolites and Peruvian guano, and the plots manured with dung and superphosphate.

The roots manured with dissolved coprolites, on the 24th of July, were plainly more advanced than those manured with ground undissolved coprolites.

Redonda phosphate appeared about equal in its effect with ground coprolites.

The precipitated phosphate and dissolved coprolites showed no marked difference on the 24th of July.

The raw bone-meal plots were behind the dissolved bone-meal and dissolved coprolite plots.

The dung and dissolved coprolite plots were more advanced than the dung and ground coprolite plots.

On the 4th of August I found the differences in the appearance of the swedes on the various plots, pretty much the same as on the 24th of July.

The weather being showery in the summer of 1880 was very favourable to the growth of roots.

On the 2nd of October I took the following notes on the field :—

Ground coprolite plots almost as good as bone-meal plots, and dissolved coprolite plots bigger roots than in the undissolved coprolite plots.

Redonda phosphate plots rather better than the ground coprolite plot, No. 1A.

Dissolved bones; good roots, growing vigorously.

Unmanured plots; roots healthy, smaller than on manured plots.

Raw bone-meal much behind dissolved bone-meal.

The roots on plots manured at the rate of 20 tons per acre are large, leaves very luxuriant and still quite fresh.

On the plot manured with half a dressing of dung and dissolved coprolites, fine roots and better than on the plot manured with dung and ground undissolved coprolites.

The roots on the plots dressed with precipitated phosphate appeared as good as those manured with dissolved coprolites.

The swedes manured with chalk were better than the unmanured swedes; the tops had a lighter green colour than on the rest of the experimental plots.

The guano and superphospate plots were still vigorously growing, and had large bulbs and luxuriant leaves.

There was an even and healthy crop on all the plots. On the unmanured plots the roots were smaller than on the manured, but quite healthy.

The swedes were pulled at the end of November and in the first week in December, topped and tailed and weighed in a clean condition, as the land was in a good condition for pulling the roots with but little adhering soil.

The following table (p. 99) shows the results of the weighings.

I do not attach any value to the weight of the tops, for some of the duplicate plots were got up after a sharp frost and more than a week later than the corresponding plots, hence the discrepancies in the weights of the tops.

TABLE showing the WEIGHT of TOPPED and TAILED SWEDES and of LEAVES GROWN on each EXPERIMENTAL QUARTER-ACRE PLOT.

		Roots.				Leaves.		
		tons.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
Plot 1 A	Raw coprolites	4	15	3	9	6	2	6
„ 1 B		5	15	1	21	11	0	5
Plot 2 A	Dissolved coprolites	6	1	3	24	9	1	7
„ 2 B		6	0	3	18	9	0	22
Plot 3 A	Redonda phosphate	5	13	0	24	7	1	24
„ 3 B		5	18	0	3	10	3	5
No. 4 A	Dissolved bone-meal	5	18	1	26	7	1	19
„ 4 B		5	14	1	23	11	0	0
No. 5 A	Precipitated phosphate	5	14	2	20	5	3	4
„ 5 B		5	15	0	0	10	0	25
No. 6 A	Unmanured	4	5	2	16	8	2	18
„ 6 B		4	10	2	13	10	0	8
No. 7 A	Bone-meal	5	2	1	18	9	1	16
„ 7 B		4	10	1	19	7	2	9
No. 8 A	Large dose of dung	6	4	3	24	10	2	20
„ 8 B		6	4	1	6	10	1	18
No. 9 A	Half a dressing of dung and dis-	6	1	1	3	11	1	19
„ 9 B	solved coprolites	6	2	0	19	7	3	2
No. 10 A	Half a dressing of dung and raw	6	1	3	21	13	0	14
„ 10 B	coprolites	6	7	1	15	9	0	19
No. 11 A	Chalk	4	15	0	6	13	0	18
„ 11 B		5	5	2	12	10	1	18
No. 12 A	Dissolved coprolites and Peruvian	6	1	3	16	12	1	4
„ 12 B	guano	6	12	2	21	12	1	11

The next table (p. 100) shows the weight of topped and tailed swedes and the weight of leaves of each plot calculated per acre, the average produce of the duplicate plots per acre, the increase of each plot per acre over the average produce of the unmanured plots, the quantities and kinds of manure used, and the cost of the manure per acre.

In explanation of the preceding results, I have to state that, although the land appeared to be fairly uniform, the results of these experiments plainly show that the part of Warren Field farthest from Crawley Mill farm buildings, and the site of plots 1 *a* (ground coprolites) and plot 7 *b* (bone meal), is not so fertile as the plots in the middle of the 6-acre field.

This is clearly seen in the anomalous result which was

Plots.	Manure Used, and Cost of Manure, per Acre.	Roots (topped and tailed) per Acre.				Leaves.				Average Produce of Roots of Duplicates per Acre.				Increase in Roots over Average Unmanured Plots per Acre.			
		tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.
1 A	$6\frac{1}{2}$ cwts. ground coprolites: cost, 22*s.* 9*d.*	19	3	1	8	1	6	0	24	21	2	2	4	3	9	3	26
1 B		23	1	3	0	2	4	0	20								
2 A	5 cwts. of dissolved coprolites: cost, 22*s.* 6*d.*	24	7	3	12	1	17	1	0	24	5	3	0	6	13	0	22
2 B		24	3	2	16	1	16	3	4								
3 A	10 cwts. of Redonda phosphate: cost, 21*s.*	22	12	3	12	1	9	3	12	23	2	1	26	5	9	3	20
3 B		23	12	0	12	2	3	0	20								
4 A	$3\frac{1}{2}$ cwts. dissolved bones: 22*s.* 9*d.*	23	13	3	20	1	9	2	20	23	5	3	14	5	13	1	8
4 B		22	17	3	8	2	4	0	0								
5 A	$4\frac{1}{2}$ cwts. of precipitated phosphate: cost, 22*s.* 6*d.* ..	22	18	2	24	1	3	0	16	22	19	1	12	5	6	3	6
5 B		23	0	0	0	2	0	3	16								
6 A	No manure	17	2	2	8	1	14	2	16	17	12	2	6		..		
6 B		18	2	2	4	2	0	1	4								
7 A	3 cwts. of bone-meal: cost, 22*s.* 6*d.*	20	9	2	16	1	17	2	8	19	5	2	18	1	13	0	12
7 B		18	1	2	20	1	10	1	8								
8 A	20 tons of dung	24	19	3	12	2	2	2	24	24	18	2	4	7	5	3	26
8 B		24	17	0	24	2	1	2	16								
9 A	10 tons of dung and 5 cwts. of dissolved coprolites ..	24	5	0	12	2	5	2	20	24	6	3	16	6	14	1	10
9 B		24	8	2	20	1	11	0	8								
10 A	10 tons of dung and $6\frac{1}{2}$ cwts. of raw coprolites	24	7	3	0	2	12	2	0	24	19	0	16	7	6	2	10
10 B		25	10	2	4	1	16	2	20								
11 A	5 tons of chalk	19	0	0	24	2	12	2	16	20	1	1	8	2	8	3	2
11 B		21	1	1	20	2	1	2	16								
12 A	3 cwts. of dissolved coprolites and $2\frac{1}{2}$ cwts. of Peruvian guano: cost, 44*s.* 9*d.*	24	7	2	8	2	9	2	22	25	9	0	18	8	16	2	12
12 B		26	10	3	0	2	9	1	16								

obtained with bone meal on plot 7 *a*, and also by the smaller produce which ground coprolites produced on plot 1 *a* in comparison with the produce of the duplicate coprolite plot No. 1 *b*.

Notwithstanding these and some minor anomalies, arising, in my judgment, mainly from the variations in the productive powers of the land upon which the experiments were tried, the results of the weighings of the experimental swede crop have brought to light some interesting facts, to which I desire to direct attention.

1. It will be seen that finely-ground coprolites, and to a still larger extent Redonda phosphate reduced to an impalpable powder, produced a considerable increase.

Thus 6⅓ cwts. of ground coprolites on an average gave an increase of 3½ tons of roots (in round numbers), while 10 cwts. of finely-ground Redonda phosphate (phosphate of alumina and iron), raised the crop to 5½ tons above the average produce of the two unmanured plots.

2. In the second place, it will be seen that 5 cwts. of dissolved coprolites, costing 22*s.* 6*d.*, produced nearly twice as much increase in clean, topped, and tailed swedes as 6½ cwts. of finely ground coprolites, costing 22*s.* 9*d.*

3. On the other hand, the addition of 6½ cwts. of coprolite powder to 10 tons of rotten dung produced, if anything, a larger increase than the same quantity of dung and 5 cwts. of dissolved coprolites.

4. The large dressing of 20 tons of rotten dung, it will further be seen, produced no more roots than 10 tons of dung and ground undissolved coprolites, or than 10 tons of dung and dissolved coprolites; and in fact, practically, the average produce was the same on the plots 8, 9, and 10. The question may therefore be raised whether 10 tons of dung alone, together with the phosphoric acid naturally present in the land, may not have furnished as much available phosphoric acid as the roots could assimilate under the conditions in which the swedes were grown, and whether it was any advantage to add either dissolved or undissolved coprolites to the dung.

At any rate, the dung experiments show that the moderate dressing of 10 tons of farmyard-manure, with the addition of some superphosphate or coprolite-powder, gave as good a crop of swedes as the large dose of 20 tons of dung.

5. The experiments further show that by far the largest increase was obtained by means of the mixed manure, composed of 3 cwts. of dissolved coprolites and 2½ cwts. of Peruvian guano; and that the expense of this application is much more moderate than that of rotten dung, which probably cannot be put on the land for much less than 7*s.* 6*d.* a ton.

6. And, lastly, it will be seen that precipitated phosphate of lime in these experiments produced almost as good a crop of swedes as dissolved bones.

It is hardly necessary for me to say that the results of field experiments of a single season are not calculated to settle definitively the question whether it be more economical, in agriculture, to use dissolved phosphatic materials in the shape of superphosphate or to apply them to the land undissolved in a finely ground state.

This spring, the six acres upon which the swede experiments were tried in 1880, will be sown with barley, and it is proposed to follow the ordinary four course rotation, and carefully to weigh the produce, in barley, clover, and wheat. We may, by these means, obtain information whether the several manures which were used in the swede experiments, will show beneficial effects in the succeeding crops.

I append analyses of the artificial manures and the chalk which were used in these experiments.

Composition of a Sample of Peruvian Guano used in Swede Experiments at Woburn.

Moisture	19·10
*Organic matter and ammoniacal salts	36·65
Phosphate of lime	26·13
†Alkaline salts	13·32
Insoluble siliceous matter	4·80
	100·00

*Containing nitrogen	8·90
Equal to ammonia	10·81
†Containing phosphoric acid	4·42
Equal to tribasic phosphate of lime	9·65
Total percentage of phosphoric acid	16·39
Equal to tribasic phosphate of lime	35·78

The Guano was a superior genuine Peruvian Guano.

Composition of a Sample of finely ground Cambridge Coprolites used in the Swede Experiments at Woburn.

Water and a little organic matter	5·51
*Phosphoric acid	25·70
Lime	44·18
Oxide of iron, alumina, magnesia, fluorine, carbonic acid, &c.	16·52
Insoluble siliceous matter	8·09
	100·00

*Equal to tribasic phosphate of lime	56·11

Composition of a Sample of Dissolved Cambridge Coprolites used in the Swede Experiments at Woburn.

Moisture	14·10
Organic matter and water of combination ..	12·15
Monobasic phosphate of lime	16·45
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(25·76)
Insoluble phosphates	8·79
Sulphate of lime .. .. Alkaline salts and magnesia	44·26
Insoluble siliceous matter	4·25
	100·00

Composition of a Sample of fine Bone Meal used in the Swede Experiments at Woburn.

Moisture	9·01
*Organic matter	30·29
Phosphate of lime	51·15
Carbonate of lime, magnesia and alkaline salts	8·01
Insoluble siliceous matter	1·54
	100·00
*Containing nitrogen	3·54
Equal to ammonia	4·29

Composition of a Sample of Dissolved Bone Meal used in the Swede Experiments at Woburn.

Moisture	6·20
*Organic matter and water of combination ..	31·50
Monobasic phosphate of lime	14·72
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(23·05)
Insoluble phosphates	15·69
Sulphate of lime .. .. Alkaline salts and magnesia	27·74
Insoluble siliceous matter	4·15
	100·00
*Containing nitrogen	2·52
Equal to ammonia	3·06

Composition of a Sample of Redonda Phosphate used in the Swede Experiments at Woburn.

Loss on heating	15·63
*Phosphoric acid	20·66
Lime	Traces
Oxide of iron and alumina	25·98
Insoluble siliceous matter	37·73
	100·00
*Equal to tribasic phosphate of lime	45·10

Composition of a Sample of Precipitated Phosphates from a Manufacturer of Glue in Cheshire, at 5l. per ton.

Moisture	28·75
Water of combination and a little organic matter	8·25
*Phosphoric acid	31·44
Lime..	29·80
Magnesia, &c.	1·76
	100·00
*Equal to tribasic phosphate of lime	68·63

Composition of a Sample of Chalk for Swede Experiments at Woburn.

Moisture	·75
Carbonate of lime	92·21
Carbonate of magnesia	·35
Oxide of iron and alumina	1·29
Alkalies, &c.	·41
Insoluble matter	4·99
	100·00

IX.—*Experiments at Burcott Lodge Farm, Leighton Buzzard, on the Growth of Swedes, with dissolved and finely-ground coprolites, with dung, and with ground and dissolved coprolites in various proportions with dung.* By R. Vallentine.

The soil upon which the experiments were tried is a rather light clay-loam, containing a good many small flints; elevation about 500 feet above the sea-level. The ground has had *no dung for 31 years.* Ten plots of one-sixth of an acre each were devoted to the experiments on swedes. The following table will show the results calculated per acre:—

Plot.	Dung.	Dissolved Coprolites.	Dry Coprolites.	Weight of Crop.
	tons.	cwts. qrs. lbs.	cwts. qrs. lbs.	tons. cwts. qrs.
1	20	..	..	16 2 0
2	10	..	..	10 10 0
3	10	3 0 0	..	13 8 0
4	10	..	5 0 0	11 4 0
5	Nothing	Nothing	Nothing	8 2 0
6	..	..	9 0 0	9 4 0
7	..	6 0 0	..	10 8 0
8	..	..	3 0 0	9 0 0
9	..	3 0 0	..	10 1 0
10	Nothing	Nothing	Nothing	8 0 0

The spring was suitable for preparing the land, which required

no cleaning. There had been a good deal of dry weather previous to the 26th of May, when a heavy rain fell which moistened the land sufficiently for seeding. On the 27th the ground was ridged and the dung applied; on the 28th all the manures were applied, the ground was ridged up and the seed sown. There was no very marked difference between any of the artificially manured plots previous to singling out, which took place on the 2nd of July. There was quite a uniform braird, the ridges were 29 inches apart—the plants along the rows were intended to be only a foot apart, but on counting several places afterwards the plants were at nearly 15 inches intervals on an average. By ordinary observation the crop looked very uniform, but by close inspection, actual measurement, and counting, there were several small blanks here and there which accounted for the number of roots being much fewer than would have been the case had there been exact uniformity in the singling and growth.

The table of results shows nothing very striking; at the same time, by careful comparison some information may be gained, especially for future comparison with similar experiments.

Plot 6—9 tons 4 cwt.—shows an increase of 22 cwt. of swedes from 9 cwt. of dry coprolites, compared with Plot 5 without any manure.

Plot 8 shows an increase of only 18 cwt. from 3 cwt. of dry coprolites, compared with the unmanured plot. Still there is a certain uniformity of results in proportion to the weight of coprolites applied. There is also a very close result from Plots 5 and 10, neither of which had any manure, so that although the increase from dry coprolites would scarcely pay for the manure, there *is an increase of crop.*

To compare Plots 7 and 9, which had dissolved coprolites, with the plots which had the undissolved, there is an increase of weight in both plots, respectively of 24 cwt. and 21 cwt., which is very much a relative increase over the dry coprolites, that the dry coprolites had over the plots without any manure.

To compare Plots 8 and 9, there is an increase of 21 cwt. per acre, from an equal weight of dissolved as against dry coprolites, although Plot 7, with 6 cwt. of dissolved coprolites per acre, against Plot 8, shows but a very small increase in proportion to the relative manurings.

The dung was very poor indeed, little better than rotted straw. 3 cwt. of dissolved coprolites increased the crop, instead of dung alone, by 2 tons 18 cwt. per acre. This may be looked upon as a very natural result—that the dung, poor as it was, supplied some nitrogen which, as is well known, must either exist in the soil by previous manurings or must be applied to any root crop if any weight of bulbs is to be looked for.

Every one who has given even the most careful attention to the carrying out of experiments knows that they are subject to a vast variety of circumstances which may affect them. The soil may in the first instance be rich or poor, light or heavy, rough or fine. The season, the climate, the time of applying the manures, the method, &c., all these and many more contingencies may occur.

Thus, by an accident, a few heaps of dung had during last winter been carted across the land where the experimental artificial-manure plots were placed, and although it was both small in weight and poor in quality, the little nitrogen in the dung told most plainly for about 3 yards wide over the crop of swedes, which were nearly doubled in size where the sprinkling of dung was laid.

The preceding experiments were carried out at Dr. Voelcker's request, and the following analyses show the composition of the ground and of the dissolved coprolites used in the experiments:—

Composition of a Sample of Mineral Superphosphate used in Mr. R. Vallentine's Experiments.

Moisture	11·75
Organic matter and water of combination ..	10·35
Monobasic phosphate of lime	17·48
Equal to tribasic phosphate of lime (bone phosphate) rendered soluble by acid	(27·37)
Insoluble phosphates	4·49
Sulphate of lime .. .. Alkaline salts and magnesia	46·79
Insoluble siliceous matter	9·14
	100·00

Composition of a Sample of finely ground Coprolites used in Mr. R. Vallentine's Experiments.

Loss on heating	4·42
*Phosphoric acid	26·18
Lime	44·54
Oxide of iron, alumina, carbonic acid, &c. ..	16·81
Insoluble siliceous matter	8·05
	100·00

*Equal to tribasic phosphate of lime .. .. 57·15

X.—*Experiments on the Use of Phosphates in growing Swedes at Tubney Warren in* 1869.* By J. W. Kimber, M.R.A.C.

The agricultural value of phosphates of various kinds and of different degrees of solubility being a somewhat undecided question, it was thought desirable to ascertain by experiment the merits of some of these as manure, at least on light sandy soils on which phosphates in some form generally constitute the staple manure for root-crops, and thus the chief means of enriching these poor lands.

At my request Messrs. F. C. Hills and Co., of the Chemical and Artificial Manure Works, Deptford, kindly supplied me with a variety of phosphatic substances from which the following were selected for trial:—

1. Bone-dust, containing from 45 to 50 per cent. of phosphate. From boiled bones.

2. Dissolved coprolite or mineral superphosphate, containing 27 per cent. of phosphate made soluble.

3. Coprolite powder (grey), containing 59 per cent. of phosphate.

4. Rhenish phosphorite powder, containing 65 per cent. of phosphate.

5. Dissolved bones prepared from bone-ash and bones, chiefly the former, containing about 40 per cent. of phosphate, of which 30 to 32 per cent. were made soluble.

6. Precipitated phosphate obtained from Rhenish phosphorite dissolved in muriatic acid and precipitated with lime.

This contained 29·46 of precipitated insoluble phosphate (besides 0·70 soluble). The result of the analysis of this substance was not received until after the manures were applied. It was then found to be poorer in phosphate than anticipated, and the quantity applied should have been after the rate of 6 cwt. per acre instead of 5 cwt.

The plan of experiment proposed was to apply these six substances to the growth of swedes the first year, and to observe their effects on this crop and on the succeeding crop of barley in 1870, and on the seeds following in 1871. For this purpose a piece of land was selected which had grown a crop of wheat in 1868 after clover, the wheat having a fair dressing of farmyard dung.

It was determined to apply the various manures in quantities of about equal money value, taking as a standard 5 cwt. of the

* These experiments were intended to be the commencement of a series, which has not been carried out, owing to a variety of causes; but the results now given appear worthy of record in comparison with those obtained last year at Woburn. —Ed.

mineral superphosphate at its price delivered here. Plots of one-twentieth of an acre were marked out, and the manures, previously well mixed with dry sand, were applied broadcast and harrowed into the land. The swede seed was afterwards drilled on the 27th of May and the land again harrowed. The plants came up well, but all on this part of the field were unfortunately destroyed in the early stage of their growth by rough winds. The plots were again drilled on the 19th of June, a time which generally answers very well for swede-planting in this district, but the dry and hot month of July proved very trying to all root-crops that season, and especially to these, which did not get quite a good start. The crop was hoed out carefully and the plants left somewhat thick, but they afterwards suffered from drought and insect attacks and became rather thin in places.

About the middle of August, after a long period of hot and dry weather, the plots were looked carefully over and the following notes were taken :—

Plot 1. Small and thin in plant; the worst plot.

Plot 2. Much better than 1; similar to 7.

Plot 3. Better than Plot 2. This and 5 are next best to 4.

Plot 4. The best plot.

Plot 5. Similar to 3.

Plot 6. Rather thin in plant, but roots nearly as good as 5 and slightly fresher.

Plot 7. As good as 6; similar to 2.

Plot 8. Second worst plot; about as 1.

WEIGHT, &c. of SWEDES grown with VARIOUS PHOSPHATES at TUBNEY WARREN, 1869.

Plots of $\frac{1}{20}$ Acre.	Kinds of Phosphates applied.	Quantity of Manure per Plot.	Quantity of Manure per Acre.	Weight of Roots per Plot.			Weight of Roots per Acre.			No. of Roots per Plot.	Average weight of Roots in ounces.
		lbs.	cwts.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.		
1	Nothing	..	..	5	3	27	5	19	3	784	13·69
2	Phosphorite powder ..	45	8	10	0	0	10	0	0	1055	16·98
3	Bone-dust	22½	4	10	2	4	10	10	3	1044	18·08
4	Dissolved bones	22½	4	12	0	7	12	1	1	1040	20·77
5	Dissolved coprolite ..	28	5	12	0	9	12	1	2	1088	19·89
6	Coprolite powder ..	42	7½	10	2	9	10	3	2	997	19·00
7*	Precipitated phosphate	28	5	10	2	0	10	2	0	1003	18·75
8	Nothing	..	..	7	2	0	7	2	0	924	14·54

There are one or two points which will not escape the attention of practical men. First, the small number of roots in

* This should have been applied at the rate of 6 cwt. to the acre.

Plots 1 and 8 is very apparent, and the reason for this will be easily understood, it being well known that a liberal allowance of manure is the best remedy for all the trials and attacks to which the young turnip plant is liable, and there is no doubt that many plants on these plots succumbed from want of that vigour which a little manure would have produced.

The difference in Plots 1 and 8 may in some measure be attributed to chance, one plot retaining 140 more roots, and these probably enjoying a greater immunity from attacks, many of the roots on Plot 1 not being larger than one's thumb. But the soil possibly may be slightly better on the side of Plot 8, and some little allowance should be made for this. The column containing the "average weight of roots" will also attract attention, the average on Plots 1 and 8, without manure, being much lower than that on any other plot, viz. about 14 ounces, whilst the lowest of the manured plots gives 17 ounces nearly, and Plot 4, with dissolved bones, gives over $20\frac{1}{2}$ ounces. This last plot had the best appearance during the whole summer, and it is difficult to explain why it did not come out better in the actual weighings. Probably the long and mild autumn was favourable for the growth of roots, and gave those on the plots with the less soluble manures, and those without manure, a chance to attain a greater size than they would have done had the period of growth been more limited. There are also a few points in regard to the mechanical condition of the manures used which should not be overlooked. The coprolite and phosphorite powders were very finely ground, and these admitted of more perfect distribution through the soil than some of the other substances. The bone-dust being specifically much lighter than the soil, would, sown broadcast and merely harrowed in, not mix so thoroughly with the soil as a heavier substance.

The precipitated phosphate was heavy and slightly lumpy, and could not be so perfectly reduced as the superphosphate and dissolved bones.

In conclusion, it may be observed that too much reliance must not be placed on a single experiment, nor would it be wise to make a hasty change in one's system of manuring upon such evidence.

At the same time it should be remembered that this is an exceptionally poor soil on which the experiment was tried, and that sandy soils generally are very poor in phosphoric acid, and are also wanting in those chemical and mechanical properties which enable other soils to retain fertilising elements.

Tubney Warren, Jan. 8, 1870.

XI.—*Results of the Experiments carried out on Manor Farm, near Rochester, by the Rochester Farmers' Club, to ascertain the relative Value of Soluble and Insoluble Phosphates.*

THE 10 plots upon which the manures were applied had manures of the same money value in each case. It will be observed that the weight varied greatly; for instance, 53 lbs. of finely-crushed bones cost the same as 112 lbs. of raw coprolites, &c.

The turnips (Purple-top Swedes) were sown June 21st, and pulled up and weighed November 11th and 12th. The tops were not removed; the fibres and soil only were taken from the turnips.

WEIGHT of TURNIPS * (including TOPS †) grown on each PLOT.

Plot.	Manures.	Quantity per Acre of value of 40*s*.	Weight per Acre.			
			tons.	cwt.	qrs.	lbs.
1	Raw Coprolites	10 cwt.	13	19	2	26
2	Dissolved Coprolites	1000 lbs.	16	9	2	6
3	Nothing	..	14	12	0	26
4	Steamed Bones ground to Flour	600 lbs.	14	19	2	16
5	Dissolved Bones	5 cwt.	15	0	1	2
6	Finely-crushed Bones	530 lbs.	12	10	0	20
7	Steamed Bones ground to Flour	600 lbs.	14	5	0	20
8	Dissolved Bones	5 cwt.	17	0	0	20
9	Finely-crushed Bones	530 lbs.	15	7	0	16
10	Raw Coprolites	10 cwt.	16	2	3	12
11	Dissolved Coprolites..	1000 lbs.	16	17	3	2
12	Nothing	..	14	13	3	10

AVERAGE WEIGHT on DUPLICATE PLOTS in ORDER of MERIT.

Plots.	Manures.	Weight per Acre.			
		tons.	cwt.	qrs.	lbs.
2 and 11	Dissolved Coprolites	16	13	2	18
5 and 8	Dissolved Bones	16	0	0	25
1 and 10	Raw Coprolites	15	1	1	5
3 and 12	Nothing	14	13	0	4
4 and 7	Steamed Bones ground to Flour	14	12	1	18
6 and 9	Finely-crushed Bones	13	18	2	18
	Average growth per Acre ..	15	3	0	24

A crop of barley taken from the land in 1879 was preceded by a crop of Green Round Turnips, upon which sheep were

* Purple-top Swedes.

† In comparing the results of these experiments with those given on the preceding pages, it must be borne in mind that in this case the *tops* were weighed as well as the roots, but that in the other experiments the weights of the roots only are given.—ED.

kept (highly fed) the whole winter of 1878. Soil, a gravelly loam, 2 feet deep, on chalk subsoil.

The following is Mr. Jamieson's analysis of the soil:—

	Upper Soil.	Subsoil.
Organic matter	7·98	3·93*
Matter insoluble in acid	80·60	89·46
Matter soluble in acid	11·42	6·61
	100·00	100·00
* Containing nitrogen	·21	·12

The above soluble matter contained:—

	Upper Soil.	Subsoil.
Sulphuric anhydride	·15	·22
Phosphoric ditto	·12	·26
Carbonic ditto	2·64	·38
Chlorine	·06	·30
Iron and alumina	3·83	2·99
Lime	4·17	1·04
Magnesia	·21	·25
Potash	·08	·13
Soda, &c.	·16	1·04
	11·42	6·61

Dr. Voelcker's Analyses of the Manures used in the foregoing Experiments.

	Dissolved Cambridge Coprolites.	Dissolved Bones.
Moisture	15·70	11·85
Organic matter and water of combination	13·70	28·90*
Monobasic phosphate of lime	16·53	13·08
(Equal to tribasic phosphate of lime bone (phosphate) rendered soluble by acid)	25·89	20·48
Insoluble phosphates	4·69	18·05
Sulphate of lime, alkaline salts and magnesia	40·59	24·27
Insoluble siliceous matter	8·79	3·85
	100·00	100·00

* Containing Nitrogen .. .. 1·93 (Equal to Ammonia) .. .. 2·34

	Finely Crushed Bones.	Steamed Bones Ground to Flour.
Moisture	8·41	7·84
*Organic matter	28·89	21·94
†Phosphoric acid	24·36	27·36
Lime	32·86	36·48
Magnesia, carbonic acid, &c.	4·70	5·13
Insoluble siliceous matter	·79	1·25
	100·00	100·00
* Containing nitrogen	3·61	2·36
(Equal to ammonia)	4·38	2·86
† Equal to tribasic phosphate of lime	53·21	59·73

DR. VOELCKER'S ANALYSES OF MANURES—*continued.*

	Ground Cambridge Coprolites.
Moisture and organic matter (loss on heating)	4·84
*Phosphoric acid	25·01
Lime	43·03
Oxide of iron, alumina, carbonic acid, &c.	18·11
Insoluble siliceous matter	9·01
.. ..	100·00

* Equal to tribasic phosphate of lime .. .. .. 54·58

XII.—*Report on the Field and Feeding Experiments conducted at Woburn on behalf of the Royal Agricultural Society of England during the Year* 1880. By Dr. AUGUSTUS VOELCKER, F.R.S., Consulting Chemist to the Royal Agricultural Society.

BEFORE reporting the results of the Woburn experiments in 1880, I would remind the reader that the Stackyard-field, situated a distance of about three-quarters of a mile from the farm-buildings of Crawley Mill Farm, upon which the greater part of the experiments are carried out, is divided into two sections. On the smaller of the two, comprising 5½ acres, 2¾ acres are set aside for the continuous growth of wheat, and 2¾ acres for the continuous growth of barley. On the larger, comprising 16 acres, the primary object for which the experiments were instituted is being carried out under the ordinary four-course system of cropping. For brevity's sake, the experiments on these 16 acres are spoken of as the Rotation Experiments.

The systematic experiments on the Stackyard-field were begun in 1877, and I have, therefore, to report the results of the fourth year field-trials.

THE EXPERIMENTS ON THE CONTINUOUS GROWTH OF WHEAT.

After the harvest in 1879 the land was ploughed on the 15th and 16th of October; drag-harrowed on the 29th of October.

The mineral manures were sown on plots 4, 5, 6, 8, and 9, on the 8th of November, and the dung on plots 10 and 11 was applied on the 7th of February, 1880.

The same kind of seed which was used in the previous

season—Browick wheat—was dibbled in between the 13th and 15th of November, 1879. It was in the ground for fully 2½ months before it got through the surface.

The salts of ammonia and nitrate of soda were sown on the 11th and 12th of March, 1880.

The dung required for the experiments on the continuous growth of wheat and barley was produced by eight bullocks, four making dung for the wheat and four for the barley experiments.

Each bullock received daily as food: 4 lbs. of decorticated cotton-cake, about 6½ lbs. of Indian corn-meal, 48 lbs. of mangolds, and 8 lbs. of wheat-straw chaff; they were put into the feeding-boxes on the 1st of December, 1879, and in the course of 5 weeks consumed:

5 cwts. of decorticated cotton-cake,
8 cwts. of Indian corn-meal,
3 tons of mangold-wurtzel, and
10 cwts. of wheat-straw chaff.

They were supplied with 11½ cwts. of wheat-straw as litter, cut into chaff of about 2 inches in length.

The bullocks were put into the feeding-boxes on the 1st of December, 1879, when their weight was as follows:

Bullocks making Manure for Permanent Wheat Experiments.

	Cwts.	qrs.	lbs.	
No. 1.	8	2	8	Total weight of four bullocks on the 1st Dec. 1879: 1 ton 15 cwts. 3 qrs. 27 lbs.
„ 2.	9	0	5	
„ 3.	9	1	0	
„ 4.	9	0	14	

On the 5th of January, 1880, the bullocks which made the dung for the wheat experiments weighed as follows:—

	Cwts.	qrs.	lbs.	Gain from Dec. 1, 1879, to Jan. 5, 1880 (5 weeks). qrs.	lbs.	
No. 1.	9	0	8	2	0	Total gain in 5 weeks: 1 cwt. 3 qrs. 1 lb.
„ 2.	9	0	17	0	12	
„ 3.	9	3	9	2	9	
„ 4.	9	2	22	2	8	

The four bullocks accordingly increased 39·4 lbs. per week, or each gained on an average 9·85 lbs. per week.

The dung was removed from the feeding-boxes on the 5th of January and put into a covered hovel, closed on all sides, and thereby all loss by drainage was avoided. At the time of its application the dung was weighed, and the requisite quantity,

containing the calculated amount of ammonia required, namely, nitrogen equal to 100 lbs. of ammonia on plot 10, and 200 lbs. on plot 11, was applied to the land as a top-dressing.

The first hoeing was given to the wheat on the 31st of March, and by that time the dung had become well incorporated with the land. The wheat was repeatedly hoed, and neither labour nor expense was spared to keep the land clean. It was press-rolled on the 3rd of May.

The wire-worm unfortunately troubled the wheat very much, and on some of the plots, notably on plot 7 (unmanured), there were a good many blank spaces which it was not possible to fill up by transplanted wheat as completely as I could have wished. On most of the plots the wheat plant was rather thin, and, owing to the attacks of the wire-worm, there were a good many blanks in some of the plots. An attempt was made, I fear without much effect, to catch wire-worms by a gang of boys who gathered no less than 15,000 wire-worms, small and large, from the $2\frac{1}{2}$ acres in permanent wheat. The plots which suffered most from the attacks of wire-worms were the two unmanured ones, more particularly the second unmanured plot, No. 7, and the plots which were top-dressed with nitrate of soda only and with sulphate of ammonia without the addition of minerals. On the plots manured with a full dressing of both mineral and nitrogenous fertilizing matters the plant was much better, and apparently not suffering nearly as much from the effects of the ravages of wire-worms as those which were unmanured or only partially manured after having grown, previous to 1880, three crops of wheat in succession.

The cutting of the wheat began on the 3rd of September and finished on the 10th of September, 1880; it was carted and stacked on the 20th of September.

The wheat was threshed in the field by means of a portable threshing-machine on the 5th of November. The straw of each plot was weighed in the field, and the corn of each plot bagged, carefully labelled, and stored in the granary until the 19th of November, when the gross weight of corn from each plot was ascertained, and the whole of the produce was measured out and the weight of each bushel taken. In each case the gross weight agreed well with the weight obtained by adding the weights of the number of bushels which each plot produced.

The Table on page 115 shows at a glance the treatment of each plot as regards manure, and the results of the harvest of 1880.

The cold weather in July and August and the heavy and continuous rains which fell in July told very unfavourably upon the wheat-crop. The corn did not properly fill up, as

Produce of Wheat. Fourth Season, 1880.

Plots.	Manures per Acre.	Produce per Acre. Dressed Corn. Weight.	Number of Bushels.	Weight per Bushel.	Straw, Chaff, &c.
		lbs.		lbs.	cwts. qrs. lbs.
1	Unmanured	478	9·6	50	13 1 18
2	200 lbs. ammonia-salts alone, applied in the spring)	572	11·5	49·5	15 0 26
3	275 lbs. nitrate of soda (applied in the spring)	496	10·5	47	15 2 18
4	200 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwts. superphosphate of lime	784	15·3	51	19 1 14
5	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts (in spring)	1292	26·6	48·6	31 3 12
6	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 275 lbs. nitrate of soda (in spring)	1204	24·2	47·7	30 0 13
7	Unmanured	688	14	49	15 2 14
8	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 400 lbs. ammonia-salts (in spring)	1460	28·4	51·4	32 0 6
9	200 lbs. sulph. potash, 100 lbs. sulph. soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime, and 550 lbs. nitrate of soda (in spring)	1308	26·4	49·6	37 3 15
10	Farmyard-manure, estimated to contain nitrogen = 100 lbs. ammonia, made from 676 lbs. decorticated cotton-cake, 1088 lbs. maize-meal, 8144 lbs. mangolds, 1356 lbs. wheat-straw, as food; and 1558 lbs. wheat-straw as litter. Weight about 4 tons	766	15·1	50·5	19 2 3
11	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1352 lbs. decorticated cotton-cake, 2176 lbs. maize-meal, 16,288 lbs. mangolds, 2712 lbs. wheat-straw chaff, as food; and 3116 lbs. wheat-straw as litter. Weight about 8 tons ..	1008	19·74	51	25 2 2

will be seen by the low weight per bushel, which ranged from 47 lbs. to 51 lbs. per bushel on the eleven experimental plots.

The plots 5, 6, 8, and 9, manured with minerals and ammonia-salts, and minerals and nitrate of soda, ripened rather sooner than the rest; next to them No. 4 ripened, then the two dung plots, 10 and 11, followed by plot 1 (unmanured), plot 2 (ammonia-salts alone), plot 3 (nitrate of soda alone), and last of all, plot 7 (unmanured). A large portion of plot 7 was wheat transplanted in spring, which accounts for its ripening later than the rest of the field and yielding better than the unmanured plot, No. 1, upon which there were more blank places.

On the whole, the plant on the experimental field was thin and unequal.

The wheat stood decidedly the best on plots 8 and 9, manured with minerals and the large dressings of ammonia-salts, and with minerals and nitrate of soda.

As far as I could judge there was only about half the plant on plots 2 and 3, as also on plots 8 and 9.

Plot 10 (small quantity of dung) was about one-fifth short of plant in comparison with plots 8 and 9 and on plot 1 (unmanured) about one-sixth less.

On plot 4 (minerals alone) the plant was better, but it was about one-eighth short in comparison with plots 8 and 9.

On the second unmanured plot (No. 7), where the blanks had been filled up by transplanted wheat in the spring, the plant was about one-tenth short, and I noticed about the same deficiency in plot 11 (larger dressing of dung).

The wheat on plots 5 and 6 (manured with minerals and smaller quantities of ammonia-salts and nitrate of soda) was thinner than on plots 8 and 9, upon which the plant tillered out better than upon plots 5 and 6.

Although the unpropitious season of 1880 and the attacks of the wire-worm to some extent interfered with the experiments on the continuous growth of wheat, the preceding tabulated statement of results nevertheless exhibits some interesting particulars, upon which I may be allowed to make a few remarks.

1. In the first place, it appears clearly that wheat cannot be grown profitably on the light soil of the experimental field at Woburn, and probably not on similar sandy soils elsewhere, for a limited number of years, even when artificial manures of the best description, containing in a readily available form both mineral and nitrogenous constituents, are applied to the land in much larger proportion than could be done in actual farm practice on account of the cost of the manures.

2. In the next place it will be seen that well-made dung had

fully as good an effect upon the wheat-crop as last year, and produced better crops than in the two seasons preceding 1879.

3. In the three preceding seasons mineral manures had but little or no material effect upon the increased production of wheat, whereas, in 1880, plot 3, manured with minerals only, yielded not only a better crop than the unmanured plots (No. 1 and No. 7), but also a greater produce than either plot 2, manured with ammonia-salts alone, or plot 3, manured with nitrate of soda alone. Thus, whilst the plot dressed with purely mineral manures yielded 15·3 bushels per acre, weighing 51 lbs. per bushel, and 19 cwts. 1 qr. 14 lbs. of straw, plot 2, dressed with ammonia-salts alone, gave only 11½ bushels per acre, weighing 49½ lbs. per bushel, and 15 cwts. 26 lbs. of straw, or in other words, the minerals alone raised the produce in corn about 4 bushels per acre above that produced by ammonia-salts alone.

In comparison with the produce of plot 3, top-dressed in spring with 275 lbs. of nitrate of soda per acre, and yielding 10½ bushels of corn, weighing only 47 lbs. per bushel, plot 3, manured with minerals alone, yielded about 5 bushels more wheat of a better quality, weighing 51 lbs. per bushel, or fully 50 per cent. more corn.

I may notice that the wheat on the two plots top-dressed in spring with ammonia-salts or with nitrate of soda, throughout the season looked weaker than that on plot 3, dressed with purely mineral manures, and scarcely better than the adjoining unmanured plots.

These experiments clearly show that, owing to the deficiency in the soil of available mineral or ash constituents of wheat, nitrate of soda or purely ammoniacal salts have little or no effect upon the produce.

In the three preceding seasons both nitrate of soda and salts of ammonia increased the produce in wheat to a larger extent than purely mineral manures.

Now, in the fourth season, the wheat appears to have felt the want of available mineral or ash constituents in the soil, and should these experiments be confirmed, as I believe they are likely to be, by the results of future experiments, it would appear that the repeated exclusive application of nitrate of soda or purely ammoniacal salts to light soils like that of the experimental field at Woburn, has the effect of exhausting the land of its mineral fertilizing matters which, entering into the composition of corn and other crops, are essential to their luxuriant growth.

The contrast in the effects of the purely mineral and the

purely nitrogenous manures on the wheat-crop in the fourth year of their application is very instructive.

Messrs. Lawes and Gilbert have shown that on the good and rather heavy wheat-land of Rothamsted the application of mineral manures to wheat grown from year to year for a period of about 25 years had scarcely any effect on the produce, whereas nitrate of soda or salts of ammonia alone largely increased the yield of wheat, without showing, after a period of 25 years, any marked indications of soil exhaustion in the available mineral constituents which enter into the composition of the ash of wheat. In recent years, that is after a considerably longer period than 25 years, Messrs. Lawes and Gilbert have noticed on the good wheat-land at Rothamsted to a slight extent a similar exhaustion in the more valuable mineral plant constituents which has manifested itself at Woburn even in the fourth year of continuous growth of wheat with purely nitrogenous manures.

4. The beneficial effects of the addition of mineral manures to nitrate of soda and to salts of ammonia, as in previous years, are very marked in the wheat experiments in 1880.

The cost per acre of the artificials employed in the experiments on the continuous growth of wheat and barley was the same as in the preceding year, namely:

			£	s.
On Plot	2. Ammonia-salts alone	about	2	2
,,	3. Nitrate of soda	,,	2	0
,,	4. Minerals alone	,,	3	5
,,	5. Minerals and ammonia ..	,,	5	7
,,	6. Minerals and nitrate of soda	,,	5	5
,,	8. Minerals and ammonia ..	,,	7	9
,,	9. Minerals and nitrate of soda	,,	7	5

The Experiments on the Continuous Growth of Barley.

The minerals applied to the barley were the same as those for the wheat experiments.

After the harvest of 1879, the land was scuffled on the 23rd of September, drag-harrowed on the 29th of October, the mineral manures were sown broadcast on the 23rd of February, the land was ploughed on the 1st of March, 1880, and the barley drilled in on the 20th of March, 1880, and finally the ammonia-salts and nitrate of soda were sown by the broadcast manure-distributor on the 24th and 25th of March, 1880.

The dung used in the barley experiments was produced by four bullocks fed and kept in precisely the same manner as the four bullocks which made the manure for the wheat experi-

ments. The dung, estimated to contain nitrogen corresponding to 100 lbs. of ammonia per acre for one plot, and 200 lbs. of ammonia per acre for the second plot, was put on the land on the 20th and the 21st of January, 1880:

Total Food consumed by Four Bullocks in Five Weeks.

Decorticated cotton-cake	5 cwts.
Maize-meal	8 cwts.
Mangolds	3 tons.
Wheat-straw chaff	10 cwts.

Wheat-straw, cut into chaff about 2 inches long, 11½ cwts. used as litter.

WEIGHT of FOUR BULLOCKS which made the DUNG for the BARLEY EXPERIMENTS.

Bullock.	Weight when put upon, December 1, 1879.			Weight on January 5, 1880.			Increase in Five Weeks.		Total Increase of Two Bullocks.
	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	qrs.	lbs.	
No. 1	9	0	23	9	0	20	0	3	loss.
„ 2	9	3	4	10	0	7	1	3	qrs. 3 lbs. 15
„ 3	9	1	24	10	0	8	2	12	
„ 4	9	1	14	Not weighed.					

One of the four bullocks was rather wild in the feeding-boxes, and all attempts to put the animal on the weigh-bridge were frustrated by the beast becoming perfectly wild and unmanageable.

Of the three remaining bullocks, it will be seen that two gained 3 qrs. 15 lbs. in 5 weeks, and the third apparently lost 3 lbs., or, practically speaking, neither lost nor gained in weight.

The two bullocks which gained in weight made 99 lbs. in 5 weeks, as they increased at the rate of 19·8 lbs. per week, or each bullock gained 9·9 lbs. per week.

The barley came up well, and there was a good even plant on all the plots. The crop was cut on the 17th of August, 1880, and carted and stacked on the 7th of September.

The barley was threshed out in the field on the 6th of November, and the straw weighed at the time of threshing; the corn was put in carefully labelled bags in the granary, and kept there until the 19th of November, when it was dressed and weighed.

The results of the weighings are embodied in the following Table:

Produce of Barley. Fourth Season, 1880.

Plots.	Manures per Acre.	Produce per Acre.					
		Dressed Corn.			Straw, Chaff, &c.		
		Weight.	Number of Bushels.	Weight per Bushel.			
		lbs.		lbs.	cwts.	qrs.	lbs.
1	Unmanured	1708	32·5	52·5	17	2	0
2	200 lbs. ammonia-salts, alone	2056	40	51·5	21	1	4
3	275 lbs. nitrate of soda, alone	2344	45·1	52	26	2	5
4	200 lbs. sulphate of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. magnesia, 3½ cwts. superphosphate of lime	1152	22·4	51·5	13	3	18
5	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. superphosphate of lime, and 200 lbs. ammonia-salts	2648	50·2	52·5	27	0	9
6	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulphate of magnesia, 3½ cwts. of superphosphate of lime, and 275 lbs. nitrate of soda	2568	48·9	52·5	31	3	0
7	Unmanured	1091	21	52	13	0	15
8	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 400 lbs. ammonia-salts	2535	48·76	52	30	3	15
9	200 lbs. sulph. of potash, 100 lbs. sulph. of soda, 100 lbs. sulph. of magnesia, 3½ cwts. of superphosphate of lime, and 550 lbs. of nitrate of soda	2228	44·6	50	36	0	20
10	Farmyard-manure, estimated to contain nitrogen = 100 lbs. of ammonia, made from 676 lbs. decorticated cotton-cake, 1088 lbs. maize-meal, 8144 lbs. mangolds, 1356 lbs. wheat-straw chaff, as food; and 1558 lbs. wheat-straw as litter. Weight about 4 tons	1857	35·7	52	19	3	13
11	Farmyard-manure, estimated to contain nitrogen = 200 lbs. ammonia, made from 1352 lbs. decorticated cotton-cake, 2176 lbs. maize-meal, 16,288 lbs. mangolds, 2712 lbs. wheat-straw chaff, as food; and 3116 lbs. wheat-straw as litter. Weight about 8 tons ..	2311	44·2	52·5	23	1	21

A glance at the preceding tabulated results, amongst other particulars, shows:

1. That minerals alone had no effect upon the produce in barley.

2. That nitrate of soda alone produced a better crop than ammonia-salts without minerals.

In the two preceding seasons the reverse was the case, and ammonia-salts alone yielded better crops than nitrate of soda without minerals.

3. That, on the other hand, the ammonia-salts and minerals on plot 5 produced rather more corn, but considerably less straw, than the same quantity of minerals and nitrate of soda on plot 6.

4. That the same minerals, with double the quantity of ammonia-salts which was used on plot 5, produced rather less corn but more straw on plot 8, than the smaller quantity of ammonia-salts on plot 5.

5. That the minerals and double quantity of nitrate of soda on plot 9 actually produced less corn but considerably more straw than half the amount of nitrate of soda on plot 6.

6. That the small quantity of dung applied to plot 10 gave a satisfactory increase.

7. That double the quantity of dung used on plot 10 produced a large increase.

8. That the second unmanured plot (7) yielded 11½ bushels less corn and 4 cwts. 1 qr. 13 lbs. less straw than the unmanured plot 1.

This is the fourth season in which the unmanured plot (1) produced more barley than the second unmanured plot (7), which clearly shows that the land on which plot 1 is situated is in a higher agricultural condition than the land on plot 7.

In comparison with the produce of the eleven experimental plots in 1879, all the plots yielded much better crops in 1880.

The dung plot (11) more especially yielded a very good crop considering the bad season of 1880. It will be seen that plot 11 produced 44 bushels of barley, weighing 52½ lbs. per bushel, or two bushels more than twice the number of bushels which the second unmanured plot (7) yielded.

It is worthy of special notice that the weight per bushel was heavier on nearly all the experimental barley plots than on the corresponding wheat plots.

The land of the experimental field at Woburn is evidently better adapted for the growth of barley than for wheat, and even in an indifferent season like that of 1880 yielded good barley crops. In a season like the last it is further noticeable that an excess of ammonia-salts or nitrate of soda, although both were used in conjunction with minerals, actually reduced the yield in corn in comparison with the produce of the plots upon which

the smaller quantity of nitrate of soda or salts of ammonia were applied, together with minerals. An excessive dose of nitrate of soda or ammonia-salts in a badly ripening season like that of 1880 appears to expend itself in the production of much straw.

The Experiments in Rotation.

Rotation No. 1.—1877, seeds; 1878, wheat; 1879, mangolds; 1880, barley.

Barley, 1880.—The mangolds grown in 1879 were fed off in the field by sheep on the 13th of February, 1880; the land was ploughed on the 1st of April, and the barley drilled in at the rate of 9 pecks per acre on the 8th of April, 1880. Dutch clover was sown between the barley on the 10th of May.

The mangolds in 1879 were grown on—

Plot 1. With dung, made from 1728 lbs. of straw as litter, 5000 lbs. of mangolds, 1250 lbs. of wheat-straw chaff, and 1000 lbs. of decorticated cotton-cake.

Plot 2. With dung, made from 1728 lbs. of straw as litter, 5000 lbs. of mangolds, 1250 lbs. of wheat-straw chaff, and 1000 lbs. of maize-meal.

Plot 3. With dung, made from 1728 lbs. of straw as litter, 5000 lbs. of mangolds, 1250 lbs. of wheat-straw chaff, and artificial manure, containing two-thirds as much nitrogen and other constituents of the manure from 1000 lbs. of decorticated cotton-cake, namely, 248 lbs. of nitrate of soda, 100 lbs. of bone-ash (made into superphosphate), 62½ lbs. of sulphate of potash, and 65 lbs. of sulphate of magnesia.

Plot 4. With dung, made from 1728 lbs. of straw as litter, 5000 lbs. of mangolds, 1250 lbs. of wheat-straw chaff, and artificial manure containing as much nitrogen and other constituents as the manure from 1000 lbs. of maize-meal, namely, 80 lbs. of nitrate of soda, 16¼ lbs. of bone-ash (made into superphosphate), 7 lbs. of sulphate of potash, and 11 lbs. of sulphate of magnesia.

The succeeding barley on plots 1, 2, and 4 was grown without artificial manure; on plot 3 with artificial manure containing one-third as much nitrogen as the manure from 1000 lbs. of decorticated cotton-cake, namely, 124 lbs. of nitrate of soda, applied as a top-dressing on the 3rd of June, 1880.

The crop was cut on the 8th of September, carted and stacked on the 23rd and 24th of September, and threshed on the 5th and 6th of November, when the straw and chaff were weighed at once in the field, and the corn was placed in carefully labelled bags in the granary. The corn was weighed and measured on the 20th of November, 1880, and the results embodied in the following Table were obtained:—

ROTATION BARLEY. PRODUCE OF ROTATION NO. 1, IN 1880, AFTER MANGOLDS FED ON THE LAND.

Plots of One Acre.		Dressed Corn.						Straw, Chaff, &c.
		Head-Corn.			Tail-Corn.			
		Weight.	Bushels.	Weight per Bushel.	Weight.	Bushels.	Weight per Bushel.	
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Without artificials (cotton-cake plot) ..	19 0 21	41·3	52	0 0 26	..	..	1 5 1 7
2	Without artificials (maize plot)	16 2 24	35·75	52·5	0 1 18	1·25	37	1 4 1 23
3	With artificial manure, containing one-third as much nitrogen as the manure from 1000 lbs. decorticated cotton-cake, namely, 124 lbs. nitrate of soda	18 2 23½	41	51	0 0 23¼	..	..	1 7 1 14
4	Without artificial manure	15 2 2	33·4	52	0 0 22½	..	..	1 2 1 5

The rotation barley, it will be seen by the foregoing tabulated results, produced a good crop.

As far as appearances went the barley on the cotton-cake plot (No. 1) looked the best and most promising throughout the growing season, and the results of the weighings showed that on plot 1, on which mangolds, manured with cotton-cake, were fed off by sheep, produced about $5\frac{1}{2}$ bushels more corn and about 1 cwt. more straw than the barley on the maize plot (2). It will further be seen that nitrate of soda on plot 3 did not yield quite so good a crop as plot 1, manured in the preceding season with dung made from decorticated cotton-cake. The barley crop on the nitrate of soda plot weighed 1 lb. less per bushel than the barley on the cotton-cake plot and produced 2 cwts. 7 lbs. more straw.

There was evidently more active growth on plot 3 than on the other plots, and had the weather at harvest-time been warm, instead of cold and wet, the nitrate of soda plot (3) probably would have yielded the heaviest return in corn. In wet and cold seasons nitrate of soda is apt to produce too much straw and rather inferior barley.

On the whole, the rotation barley in 1880 was a fair crop and afforded evidence of the superior fertilising properties of decorticated cotton-cake in comparison with maize-meal.

Rotation No. 2.—Four acres. 1877, mangolds; 1878, barley; 1879, seeds; 1880, wheat.

Wheat, 1880.—The seeds were fed off in 1879 by sheep. On plot 1 the sheep consumed as additional food 672 lbs. of decorticated cotton-cake. On plot 2 they consumed 728 lbs. of maize-meal. On plots 3 and 4 no additional food was given, but on plot 3 the wheat was manured with artificial manures, containing as much nitrogen and other fertilising constituents as the manure from 672 lbs. of decorticated cotton-cake, namely, 275 lbs. of nitrate of soda, 73 lbs. of bone-ash (made into superphosphate), $45\frac{1}{2}$ lbs. of sulphate of potash, and $47\frac{1}{2}$ lbs. of sulphate of magnesia.

And lastly, on the fourth acre (plot 4) the wheat was manured with artificial manures, containing as much nitrogen and other fertilising constituents as the manure from 728 lbs. of maize-meal, namely, $58\frac{1}{4}$ lbs. of nitrate of soda, $11\frac{3}{4}$ lbs. of bone-ash (made into superphosphate), 5 lbs. of sulphate of potash, and 8 lbs. of sulphate of magnesia.

The sheep came off the land on the 5th of November, 1879, when the land was ploughed and got ready for wheat-sowing, which took place on the 18th of November, 1879, when also the mineral manures were sown broadcast.

The nitrate of soda was applied on the 24th of March, 1880.

ROTATION WHEAT. PRODUCE OF ROTATION No. 2, IN 1880, AFTER SEEDS FED ON THE LAND IN 1879.

Plots of One Acre.		Dressed Corn. Head-Wheat. Weight.	Dressed Corn. Head-Wheat. Bushels.	Dressed Corn. Head-Wheat. Weight per Bushel.	Dressed Corn. Tail-Wheat. Weight.	Dressed Corn. Tail-Wheat. Bushels.	Dressed Corn. Tail-Wheat. Weight per Bushel.	Straw, Chaff, &c.
		cwts. qrs. lbs.		lbs.	cwts. qrs. lbs.		lbs.	tons. cwts. qrs. lbs.
1	Seeds fed off by sheep, which consumed 672 lbs. of decorticated cotton-cake ..	9 2 17	21·2	51	0 2 15¾	1·5	47·5	1 14 0 26
2	Seeds fed off by sheep, which consumed 728 lbs. of maize-meal	10 3 25	24·1	51	0 3 26	2·1	48	1 18 2 0
3	Seeds fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much nitrogen, potash, phosphoric acid, &c., as 672 lbs. of decorticated cotton-cake	9 0 16½	20	51	0 3 7½	1·9	47	1 19 2 18
4	Fed off by sheep without cake or corn, top-dressed in spring with artificial manures, containing as much fertilising matter as the dung from 728 lbs. of maize-meal ..	10 3 13¼	23·5	51·8	0 2 27¾	1·6	48·5	1 17 1 1

The wheat was cut between the 31st of August and the 6th of September, 1880, and carted between the 11th and 20th of September, and threshed out in the field on the 4th of November. The straw and chaff were weighed on the field at the time of threshing, and the corn was kept in labelled bags in the granary until the 20th of November, when it was weighed and measured, each bushel being weighed as a check of the gross weight of corn of each plot.

The Table on page 125 shows the results that were obtained.

The wheat-crop looked strong and healthy and promising in spring, but the long-continued rains and cold weather in the latter part of July and in August had a very bad influence and prevented the corn from filling up and properly ripening.

In 1879 the produce on the four rotation acres varied from 35½ bushels to 37·9 bushels, weighing only from 54 to 54½ lbs. per bushel. In 1880 the produce amounted only to 20 to 24 bushels, weighing not more than 51 lbs. per bushel, or less than the average weight of a bushel of barley grown in 1880 in rotation No. 1.

It will be observed that the highest manured plots—1 (decorticated cotton-cake) and 3 (artificials equivalent to fertilising matters in the cotton-cake)—yielded less corn than the two plots which were not manured with so large a proportion of nitrogenous fertilising matters.

This is specially noticeable in the case of plot 3, which received in spring a top-dressing of 275 lbs. of nitrate of soda. Whilst the nitrate of soda produced nearly 2 tons of straw, it gave only 20 bushels of very light wheat, or about 4 bushels less than plot 2, upon which the seeds of the previous year had been fed off by sheep consuming maize-meal.

It thus appears that in cold and wet seasons like that of 1880, and on light land, highly manured wheat, and more especially wheat top-dressed in spring with nitrate of soda, does not yield so well as, and produces more straw in proportion to corn than, wheat not so highly manured with nitrogenous fertilisers.

Rotation No. 3.—1878, seeds; 1879, wheat; 1880, roots; 1881, barley.

Mangolds, 1880.—The requisite quantity of dung for the rotation mangolds was made by 8 bullocks, 2 of which, in addition to mangolds and straw-chaff, consumed 1000 lbs. of decorticated cotton-cake, 2 others 1000 lbs. of maize-meal as an additional food; the 4 remaining bullocks were fed upon mangolds and straw-chaff only.

The bullocks were put up in the feeding-boxes on the 4th of March, and by the 21st of April they had consumed the food required for producing the dung for the 4 acres of the rotation

mangolds. The straw used as litter was cut rather shorter than in the preceding year, and instead of 1728 lbs. of straw used in each pen, only 1350 lbs. of straw, cut into chaff, were used as litter in 1880.

The wheat-stubble of the preceding year was ploughed for the first time on the 19th of February, 1880, and for the second time on the 23rd of April, at which time the dung was applied to the land. The dung was in a short and fairly rotten condition. The mangold seed was drilled in on the 28th of April, and the mineral manures were sown on the 6th of May, 1880. The seed came up well, and by the middle of May there was a good even plant all over the 4 acres.

The nitrate of soda on plots 3 and 4 was sown by hand between the rows and round the plants on the 25th of June, 1880, after the plants had been singled out and been well established in the land.

The effects of the nitrate of soda soon became visible, and throughout the season the mangolds on plot 3 took the lead.

In the beginning of November the mangolds were taken up, cleaned, topped and tailed, and weighed, when the results shown in the following Table were obtained:

ROTATION, No. 3, MANGOLDS, 1880, AFTER WHEAT.

Plots of One Acre.		Produce per Acre.							
		Roots.				Leaves.			
		tons.	cwt.	qrs.	lbs.	tons.	cwt.	qrs.	lbs.
1	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. decorticated cotton-cake	19	10	2	20	3	15	3	20
2	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff, and 1000 lbs. of maize-meal	18	19	3	6	3	6	2	16
3	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing two-thirds as much nitrogen, and the other constituents, of the manure from 1000 lbs. decorticated cotton-cake; namely, 248 lbs. nitrate of soda, 100 lbs. of bone-ash (made into superphosphate), 62½ lbs. sulphate of potash and 65 lbs. sulphate of magnesia	24	10	1	25	3	15	2	6

Rotation No. 3—*continued.*

Plots of One Acre.		Produce per Acre.	
		Roots.	Leaves.
		tons. cwt. qrs. lbs.	tons. cwt. qrs. lbs.
4	With dung, made from 1350 lbs. straw as litter; 5000 lbs. mangolds; 1250 lbs. wheat-straw chaff; and artificial manure, containing as much nitrogen, and other constituents, as the manure from 1000 lbs. maize-meal; namely, 80 lbs. nitrate of soda, 16¼ lbs. bone-ash (made into superphosphate), 7 lbs. sulphate of potash, and 11 lbs. sulphate of magnesia	20 18 1 13	3 6 2 20

1880 was a remarkably good year for growing roots. It was indeed as exceptionally favourable to root-crops, as it was bad—at least at Woburn—for wheat. Nothing can show more plainly the influence of the season upon our cultivated crops than the Woburn experiments on mangolds in 1879 and in 1880.

In both years the roots were grown in the same field; in both seasons the land was kept scrupulously clean, and in fine condition for the reception of the seed; it was treated exactly alike; precisely the same manures and in the same quantities were used in 1879 as in 1880; the mangold seed was good, and there was an even plant throughout the field in both years: and yet the mangolds in 1879 turned out a miserable failure, and in 1880 a splendid crop. Thus in 1879 the cotton-cake dung on plot 1 produced only 4½ tons of mangolds, in round numbers, and in 1880 not less than 19½ tons; and whilst the heaviest crop on plot 3 amounted to not quite 8 tons, the same plot in 1880 yielded 24½ tons of topped and tailed mangolds.

The only explanation which occurs to me to suggest of these remarkable differences is that in 1879 May and June were very cold months, whilst in 1880 they were warm and more genial to root-crops. In 1879 I noticed that the young mangold plants for a month or 6 weeks appeared to stick fast in the soil, making hardly any progress, whilst in 1880 they made a fair start at once and grew away lustily without an apparent check, much encouraged in their growth by the almost continuous showers of rain which fell in the months of June and July, followed by a month of comparatively dry weather. For the sake of comparison I add the following Table:—

Produce of Rotation Mangolds in the Years 1878, 1879, and 1880.

		Produce per Acre.							
		Roots.				Leaves.			
		tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.
Plot 1 ..	1878	13	2	1	0	2	15	1	0
	1879	4	10	1	8	2	2	1	14
	1880	19	10	2	20	3	15	3	20
Plot 2 ..	1878	11	16	0	0	2	15	0	21
	1879	4	9	3	18	2	1	0	17
	1880	18	19	3	6	3	6	2	16
Plot 3 ..	1878	18	13	0	20	3	13	3	0
	1879	7	19	0	26	2	19	1	8
	1880	24	10	1	25	3	15	2	6
Plot 4 ..	1878	12	15	1	12	3	3	3	5
	1879	5	15	3	22	2	3	3	0
	1880	20	18	1	13	3	6	2	20

The character of the season as regards rainfall will be seen from the following Table, showing the rainfall at Aspley, a village about half a mile from the Woburn experimental field:

Rainfall taken at Aspley, about half a mile from the Woburn Experimental Field.

Year.	Month.	Rainfall in Inches.	No. of Wet Days.
1879	October ..	·69	10
	November ..	·67	11
	December ..	·56	10
1880	January ..	·41	5
	February ..	2·46	19
	March	1·71	6
	April	1·62	15
	May	·94	10
	June	1·74	20
	July	6·21	24
	August ..	·46	8
	September ..	4·36	12
	Total ..	21·83	150

In the first 6 months 6·50 inches fell in 61 days.

In the second 6 months 15·33 inches fell in 89 days.

On the 14th of July, 1880, 2·21 inches fell in a single day, which, with two exceptions, is the heaviest rainfall on record since 1856.

Rotation No. 4.—Four acres: 1878, mangolds; 1879, barley; 1880, seeds; 1881, wheat.

Seeds, 1880.—In the spring of 1880 there was a magnificent plant of clover and Italian rye-grass, which had been sown with the barley in the preceding year. The clover and rye-grass were fed off by sheep in the course of the growing season. On one acre, 672 lbs. of decorticated cotton-cake were consumed; on the second acre 728 lbs. of Indian corn-meal; and the third and fourth acres were separately eaten off without any purchased food.

On each of the four acres 10 sheep were put on the 30th of April; and as the clover was very strong 10 sheep could not consume it with sufficient rapidity, for which reason 5 additional sheep were put on each acre on the 27th of May. By the 15th of June the sheep had gone once over the green clover; they were then weighed and found to have given the following increase:

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 15 sheep, each sheep receiving about ½ lb. decorticated cotton-cake; 10 sheep on the land 47 days and 5 sheep 18 days	97¼
2.	Fed-off by 15 sheep, each sheep consuming as additional food about ½ lb. maize-meal; 10 sheep on the land 47 days and 5 sheep 18 days	98½
3.	Fed-off by 15 sheep, without other food; 10 sheep on the land 47 days and 5 sheep 18 days ..	76¾
4.	Fed-off by 15 sheep, without other food; 10 sheep on the land 47 days and 5 sheep 18 days ..	140¾

The clover on plot 4 was by far the best, and the sheep did better upon it than on the three other plots, although they had cake and corn on plots 1 and 2.

On the 15th of June, 5 sheep were drawn off from each acre, and on the 16th of June, 10 sheep were put on each acre plot to feed off the seeds the second time. By the 26th of July they had gone twice over the clover; they were then weighed, with the following results:

Clover fed-off by Sheep the second time.

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 10 sheep, eating about ½ lb. of decorticated cotton-cake per day; on land 41 days ..	100½
2.	Fed-off by 10 sheep, eating about ½ lb. of maize-meal per head per day; on land 41 days ..	100¾
3.	Fed-off by 10 sheep, without additional food; on land 41 days	47¾
4.	Fed-off by 10 sheep, without additional food; on land 41 days	30¾

Decorticated cotton-cake, it will be seen, gave almost exactly the same increase as maize-meal, and on both plots No. 1 and No. 2 the additional corn or meal told on the weight of the sheep more than in the first period, when no doubt the clover was more abundant and better matured, and in consequence more nutritious than the rapidly grown green produce in the second period.

On the 26th of July 10 sheep were again put on each of the four-acre plots, and by the 30th of August the sheep had gone over the clover-seeds for the third time. They were weighed on the 30th of August, and found to have gained in weight as follows:

Clover fed-off by Sheep the third time.

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 10 sheep, having decorticated cotton-cake as additional food; on land 35 days ..	$45\frac{1}{4}$
2.	Fed-off by 10 sheep, having maize-meal as additional food; on land 35 days	88
3.	Fed-off by 10 sheep, without additional food; on land 35 days	$86\frac{1}{4}$
4.	Fed-off by 10 sheep, without cake or corn; on land 35 days	89

With the exception of the sheep on plot 1 the increase in the live-weight of the three remaining plots was practically the same. Somehow or other the cotton-cake did not appear to have done any good to the sheep on plot 1 during the month of August.

On the 13th of September, 10 sheep were again put on each of the four acres, and by the 1st of October they had fed-off the clover. They were weighed on that day and sold.

Clover fed-off by Sheep the fourth time.

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 10 sheep, having decorticated cotton-cake as additional food; on land 18 days ..	$18\frac{3}{4}$
2.	Fed-off by 10 sheep, having maize-meal as additional food; on land 18 days	29
3.	Fed-off by 10 sheep, without additional food; on land 18 days	$8\frac{3}{4}$
4.	Fed-off by 10 sheep, without additional food; on land 18 days	53

The following Table shows the number of sheep fed on each acre, the quantity of purchased food consumed (if any), the

number of days the animals were kept on the land, and the total increase in live-weight yielded:

Plots.		Increase in Live-weight. lbs.
1.	Fed-off by 15 sheep, with 672 lbs. decorticated cotton-cake; 10 sheep on land 141 days and 5 sheep 18 days	261¾
2.	Fed-off by 15 sheep, with 728 lbs. maize-meal; 10 sheep on land 141 days and 5 sheep 18 days	316¼
3.	Fed-off by 15 sheep, without other food; 10 sheep on land 141 days and 5 sheep 18 days	219½
4.	Fed-off by 15 sheep, without other food; 10 sheep on land 141 days and 5 sheep 18 days	313½

The barley with which the clover-seeds were sown in the preceding year was much lighter on plot 4 than on the three other plots. The clover on plot 4, being less covered than on the other plots, was a much stronger plant and yielded more food, which accounts for the greater increase in the live-weight of the sheep which fed-off the clover-seeds on plot 4.

On the whole, the sheep did not do as well on clover-seeds in 1880 as in the preceding year. In 1879 the sheep were put on the clover for the first time three weeks later than in 1880, and the interval between their going over the clover the second and third time, owing to the slower growth of the clover in 1879, was longer than in 1880. When the sheep were put on the clover on the 30th of April, 1880, the herbage was so abundant that 5 additional sheep had to be put on the land in order to keep down the clover, and the abundance of rain in June and July in 1880 encouraged a very rapid and luxuriant second and third growth; but notwithstanding its luxuriance, the clover appears to have been less nutritious than the more gradually grown and no doubt more matured produce of 1879.

XIII.—*The Principles of Horse-Shoeing.* By George Fleming, F.R.C.V.S., Army Veterinary Inspector.

The necessity for protecting the foot of the horse from undue wear has been recognised, more or less, in all countries from the earliest times, and the amount and kind of protection have been dependent not only upon the soil and climate of the different regions in which horses have been largely utilised, but also upon the ingenuity and resources of the people who employed them.

In a state of nature, and when not compelled to travel more or less continuously upon hard rugged ground, the horny case of the horse's foot is ample protection, and the growth of horn is sufficient—sometimes more than sufficient—to meet the demands of wear. With some breeds of horses the hoof-horn is naturally dense and tough, and the growth rapid. This characteristic is more especially noted in hot dry climates, with rocky or sandy ground, and in these the hoofs are long, narrow, and concave in the sole. In such countries horses can often perform a fair amount of work without any protection to their feet. In temperate and northern climates, however, where there is more or less moisture, and the ground is soft, horses' hoofs are more inclined to be expanded and the soles flat, while the horn itself has much less tenacity and density, and soon wears away when the animals travel considerable distances, especially on stony ground or artificial roads.

In all climates, when horses have to toil continuously on hard ground, and particularly if it be broken and stony, some kind of provision has to be made against undue wear of the hoofs, and consequent lameness and inefficiency. In South Africa and some other parts of the world, a good amount of work can be performed by horses with unprotected feet; but whenever the toil is severe, and the soil is hard and rugged, then the wear of horn is not compensated for by its growth, and the animals are soon footsore and lame, from the sensitive parts contained in the hoof becoming exposed and injured.

Therefore it is that, in the most favoured countries in this respect, a protection of some kind has to be resorted to, if the powers of this most useful of all animals are to be regularly and completely utilised for the benefit of man. Horses are generally shod with iron shoes in the East; and even where the soil is sandy, the Arabs avail themselves of this device; and their farriers hold a high place in the social scale, because their services are so valuable in increasing the usefulness of the indispensable steed. In other countries where shoeing is not regularly resorted to—as in the Transvaal—this is not so much because there is little necessity for it, as because there are very few farriers. The Boers gladly avail themselves of the services of these artisans whenever they have the opportunity. In regions where our method of shoeing is unknown or cannot be practised, horses when footsore are either led, or turned adrift until their hoofs have grown sufficiently; or these are covered with raw-hide sandals, or the soles are garnished with pieces of deer- or cow-horn. Until the campaign in North China in 1860, the Japanese employed sandals made of rice-straw for their horses' feet. Though the hoofs of their diminutive horses

are remarkably sound and tough, yet they found, from long experience, that in journeying on rocky ground these soon became so much worn that lameness ensued. And so it was that when a traveller started on a long journey among the mountains, he was furnished with a dozen or two of these straw slippers, which were attached to his saddle. When his hack began to limp he had to dismount and tie a pair of these curious contrivances on the front feet, and as their durability was not great, the operation had to be performed at brief intervals. The only consolation the traveller could discover under these circumstances, was in the fact that these sandals were very cheap, and could be bought in every village. Having to purchase a great number of Japanese horses for the use of the army during our advance on Peking, several of my farriers were sent to Japan to attend to them, and the natives for the first time saw iron shoes attached to hoofs by nails. Though much astonished at first, they soon availed themselves of the Western invention, and it is now probably well known to every denizen of that enterprising kingdom as the most efficient and least troublesome mode of preventing lameness in their horses from hard travelling.

When the art of shoeing was invented, it is difficult to ascertain. I have devoted many years' research to the settlement of this question, and in tracing the history of horse-shoeing from the earliest up to the present time. The result of these labours has been given in my work on 'Horse-shoes and Horse-shoeing,' but it may here be mentioned that there is some probability that it was known about B.C. 300, as a beautiful coin of Tarentum—a small island near Brindisi—of that date represents a horse being shod. It is not improbable that the Gauls and Celts shod their horses as we now shoe them, horse-shoes and nails having been found in Gaulish graves—especially in Alesia, where the Gauls made their last stand against the Romans; and they have also been discovered with Ancient British remains in this country. They have certainly been found with Roman remains in many parts of England, and numbers of these shoes and nails figure in our museums—as at York and Canterbury, and in the Guildhall and the British Museum. All these Roman and pre-Roman horse-shoes and nails, British and Continental, are peculiar; they are exactly of the same shape, and nearly of the same dimensions, which are small—proving that the native horses were rather under-sized. The discovery of horse-shoes with British and Roman remains in this country disposes of the assertion, which is often repeated in 'Haydn's Dictionary of Dates,' that the art of shoeing was introduced into England by William the Conqueror.

In a climate like our own, some substantial hoof-armature must have been greatly desired by such an equestrian and chariot-driving people as the Ancient British; and the traditions and superstitions which yet cling to horse-shoes and horse-shoeing appear to be derived from pre-historic times, when the Druids were not only the priests, but the skilled workers in metals—the armourers and shoers, who pursued their craft in obscure places and caves, each being a kind of Wayland Smith.

It is somewhat remarkable that these primitive shoes and nails are evidence that the farriers of those days had a better notion of what was necessary, than many of the more civilised workmen of modern times. The shoe is very light, has usually two small calks, and three nail-holes on each side, into which fitted six very large-headed nails; so that the horse had eight good projections on the surface of each shoe, which ensured an excellent foothold with the least possible weight, and without disturbing the balance of the limb or position of the foot.

From that early period until the present time, this most important art, which has lent so much aid to civilization by increasing the usefulness of the horse a thousandfold, has undergone many modifications in so far as the shape, weight, and application of the shoe are concerned. But it is greatly to be feared that these modifications have not always been to the advantage of the horse, or that of his owner. It was a bold, indeed a startling conception, to fasten a rim of metal to a horse's hoof by means of nails—an invention quite as important as that of the wheel; and the daring but ingenious individual who first attempted to protect the foot of the noble animal in this way, could have no idea of the service he was rendering his own species. But his object was simple. He saw that, if a horse travelled much, and particularly on hard roads or during wet weather, the hoof was worn away faster than it grew, and that, if the travelling was continued sufficiently long, lameness resulted. He would readily perceive that the part most subject to wear was the lower margin of the foot, and if he could firmly attach a small piece of some material harder than the horn, and of the outline of the part so exposed, this serious cause of inefficiency would be at once got rid of. By his invention success was complete, and the horse was transformed from a comparatively useless creature into an animal next in importance to man himself in promoting civilisation, and without which modern society could scarcely exist.

The primitive shoer knew all that was necessary to be known with regard to his craft, and we may surmise that he was more of a benefactor to the horse-owners of his time than many of the modern farriers generally have been. For the last four or five

centuries shoeing has not been conducted on rational principles. The shoes have been something more—or shall we say less—than a mere protection to the hoof. They have varied in shape and in weight, but these variations have always been to the injury of the horse, and the consequent disadvantage of horse-proprietors. Some of the variations have been productive of abominable cruelty, and have caused a terrible sacrifice of horse-life and horse-utility. They appear to have reached their maximum when false notions as to the functions of the horse's foot were promulgated by men who only studied the hoof, and forgot that this was merely the covering to the organ, not the organ itself: that it was only to the foot as the cranium is to the brain, or as the leather shoe is to the human foot—in fact, that it was not much more than a "covering or protection." The theory was that the hoof expanded and contracted at the sides, while the sole descended and ascended, every time the foot was placed on the ground and raised again. To this theory the treatment of the hoof was subordinated. To facilitate elasticity the sole was ruthlessly mutilated, until it was so thin that it yielded to the pressure of the thumb, and the blood often oozed through the horn. Shoes much too small were applied, and the horn to which they were nailed was rasped away, so as to make the foot fit the shoe. Everything was only too frequently done which should not have been done: Nature's arrangements were subverted to suit very erroneous notions, and, as a consequence, inconvenience, pain, lameness, and premature wearing-out of horses were witnessed. Hence shoeing has oftentimes been designated an evil and a curse to the equine species; and the truth of this no one can deny when the operation is performed by ignorant men. But when it is carried out with intelligence and a due regard to what is necessary, it is a great boon to mankind, and does not injure horses in the slightest degree. Much has been written against the iron fetter, as the shoe has been designated, and the blame for every kind of lameness has been attributed to it; while some authorities have ascribed the great expenditure of comparatively young horses in our large cities to shoeing. A properly applied shoe is not a fetter to the functions of the foot, as the part to which it is attached has scarcely any movement, and the hoof itself might more fitly receive this appellation; and with regard to all horses being prematurely worn out through shoeing, the statement must be very much qualified. Without shoes horses might last longer, as owing to their hoofs wearing too quickly, they could not work continuously, and a long time would be required to repair the damage by new growth; while with shoes they are made to toil incessantly, and perform duties which could never be attempted with unshod hoofs. With

rational shoeing, horses will still be worn out before their natural lease of life expires ; though not through the shoeing, but because of the toil the shoeing enables them to undergo.

As shoeing is ordinarily practised, it is a difficult art—the difficulty being solely due to the mutilations the hoofs sustain at the hands of the farrier. As shoeing ought to be practised, nothing can be simpler or easier. The foot of the horse is a perfect organ, thoroughly adapted for its purpose, and man cannot improve it. It only needs protection from undue wear, and this protection is easily and readily afforded by arming the hoof with metal sufficient to last for a certain period.

In order to understand the general principles of shoeing, a glance at the different parts of the hoof is necessary. The wall is that portion which surrounds the foot, and is alone seen when this is placed on the ground. It is fibrous in structure, the fibres passing from above to below, as they grow from where the skin terminates. Externally the fibres are dense and resisting, but those nearer the interior gradually become soft and spongy. The growth of the wall is indefinite, it being the part which has to sustain wear through contact with the ground.

When the foot is lifted, the sole and frog are seen on its lower or ground surface. The sole is usually more or less concave in a healthy foot. It is fibrous, like the wall, its fibres passing in the same direction ; but they are much softer, and their growth is definite, they breaking off in the form of flakes when they have reached a certain length. The frog is a triangular mass of somewhat soft and elastic fibrous horn, situated at the posterior part of the sole. Like that part, its fibres are also of definite growth, and flake off in large patches from time to time.

The wall sustains weight and wear on all kinds of ground ; the sole is adapted for sustaining weight on soft ground more particularly ; while the frog has a most important use in acting as a cushion to support the powerful tendon which flexes the limb, in diminishing jar, and in preventing slipping.

The unpared sole and frog of the healthy foot need no protection on any kind of soil. The flakes of loose horn on the former serve a very useful purpose in retaining moisture, and so keeping the solid horn beneath soft and elastic, while they act as so many springs when the foot is placed on projecting stones. The more the frog is exposed to wear, so the larger and sounder it grows, and the better it is for the entire foot and limb.

The fore foot is of more importance, in the matter of shoeing, than the hind one, inasmuch as it has to support much more weight, and is consequently more exposed to disease and injury.

The fore foot, when well formed, is nearly, if not quite circular; the hind foot is somewhat oval, the frog smaller, and the sole more concave.

When the hoof is shod, the wall is not exposed to wear, and therefore would grow to an indefinite, and consequently most inconvenient, length if the shoe should chance to be retained too long, and the excess in growth of horn not removed. The sole and frog, on the contrary, never cause inconvenience, as their growth is limited.

What is required in shoeing, then, is merely protection from undue wear, with the least possible interference with, or disturbance to the functions of, the foot and limb. The excess in length of the wall must be removed at frequent intervals—between a fortnight and a month, according to the activity of growth; but the sole and frog, if healthy, should not be disturbed. Not a grain of iron more than is absolutely necessary should be allowed as a protection; and this question of weight of shoes is an important one, especially with horses which are compelled to travel beyond a walk. There are no muscles below the knee and hock, and those which are chiefly concerned in the movements of the limb arise high up, and act upon short levers. An ounce weight at the shoulder or stifle, therefore, progressively and rapidly increases, until at the foot it has become equal to several pounds. Therefore it is that a shoe six or twelve ounces heavier than is absolutely necessary to protect the wall from wear, occasions a great waste of muscular power of the limb, and consequent fatigue. If we consider the rapidity with which the weight increases from the shoulder or hip towards the foot, the number of steps a horse takes in a journey of a few hours, and that there are four feet so surcharged, we shall gain some notion of the many needless tons which the animal has been compelled to carry, and the strain thrown upon foot and limb—a strain they were never intended, and are not adapted by Nature, to bear. All shoes should, then, be as light as may be compatible with the wear demanded from them.

For all horses, except, perhaps, the heaviest animals employed in drays and heavy waggons, the lower or ground face of the shoes should be concave, and the upper or foot surface plane, or nearly so. They should be retained by the smallest number of nails possible—six or seven in the fore shoes, and eight in the hind shoes. Calks should never be employed. With the heaviest horses—the dray or waggon animals—it may be advantageous to have toe and heel calks, to afford secure foothold.

The procedure in shoeing is simple in the extreme. When the old shoe is removed from the hoof, nothing more is required

than to remove the excess in growth of the wall by means of the rasp, applied to the lower margin or ground or sole edge—not the front of the wall. The amount to be removed will depend upon the growth, and of this the farrier's skill in his art should enable him to judge. It is at the toe or front portion that the excess is found, and this should be removed until, in an ordinary hoof, when placed on the ground, the angle should be about 50° or 52°. The sole or frog should not be touched, not even the loose flakes removed, and all the work ought to be accomplished by means of the rasp. Paring out and hacking at these parts with the drawing-knife should be absolutely condemned as destructive to the foot.

In reducing the wall to a proper length, care should be exercised in keeping both sides of the same height; as, if one is left higher than the other, the foot, fetlock, and indeed the whole limb, will be thrown out of the perpendicular. This causes the horse to travel painfully, as it twists the joints, and in time leads to disease. Nearly always the inside of the foot is left higher than the outside, and this throws severe strain on the outside of the foot and fetlock. Standing in front of the horse when the foot is on the ground, one can perceive at once whether this deviation is present. In a well-formed foot and leg, a plumb-line should fall from the point of the shoulder through the middle of the knee, shank, pastern, and front of the hoof.

The wall having been reduced sufficiently, the shoe should fit *full* all round the circumference, and project slightly beyond the heels. Heat is not absolutely necessary in fitting it, or procuring accurate co-aptation between it and the hoof. The nails should take a short thick hold of the wall, so that, if possible, the old nail-holes may be obliterated when the excess of horn is removed at the succeeding shoeing. With the fore foot the nails should be driven home more firmly at the toe than the heels, particularly the inside heel. The clinches must be laid down as smoothly as possible, and with only the most trifling rasping. The front of the hoof, or wall, should on no account be otherwise touched with the rasp, but ought to pass in a straight line from the top, or coronet, to the shoe. Rasping this part of the hoof is most injurious, and should not be tolerated on any consideration. It removes the dense tough fibres which are best adapted for holding the nails that retain the shoe, and exposes the soft spongy horn beneath; this soon dries, cracks, and breaks, and does not afford sufficient support to the nails.

The evils of shoeing, then, as generally practised, are: 1. Paring of the sole and frog; 2. Applying shoes too heavy

and of a faulty shape; 3. Employing too many or too large nails; 4. Applying shoes too small, and removing the wall of the hoofs to make the feet fit the shoes; 5. Rasping the front of the hoof.

The shoe should give the foot a level natural bearing on the ground. Calks are hurtful, and may easily be dispensed with, if the shoes have a concave ground surface, and the frog is allowed to come fully in contact with the ground.

The manufacture of horse-shoes and nails by machinery is destined to confer a great boon on horse-owners. The North Metropolitan Tramway Company has more than two thousand horses, and these are all shod with the Seeley horse-shoes and nails. The shoes are of the pattern I have for years recommended, and are made of excellent iron, which allows them to be altered in shape without the necessity for heating. The shoes are altered and fitted in a cold state, and the nails being pointed ready for use, a horse can be shod in very much less time than in the ordinary way, and certainly very much better. One farrier can easily keep from eighty to a hundred horses regularly shod, and the method is so economical that it is calculated the Company has saved more than 1000*l.* per annum since they adopted it.

Shoes with a concave ground surface, such as I have approved, not only secure a better footing on paved roads and grass-land, but they do not afford any space for the lodgment of stones, mud, &c., between them and the hoof; in heavy ground suction is greatly diminished, while in snow, "balling" is not so likely to take place.

With the Seeley shoes and nails, the suppression of paring and unnecessary rasping, and the method of cold fitting, the farrier's art is deprived of its most pernicious evils, and rendered so simple that there should be no more mystery or excuse for not understanding it on the part of horsemen.

With regard to special shoeing and shoes for particular cases, I do not venture to speak in this place. These are more in the domain of the veterinary surgeon than the amateur or farrier; but it may be noted that in these instances the art of farriery lends invaluable aid to those who know best how to avail themselves of its resources.

XIV.—*Report on Liver-Rot.* By Finlay Dun, 2, Portland Place, London.

A succession of wet seasons has spread liver-rot widely through most of the midland, western and southern counties of England. The average rainfall over most of this area for 1879 and 1880 considerably exceeds 30 inches, which is fully one-fourth over the average. In Birmingham and various of the midland counties it reached 36 inches. A similarly augmented rainfall occurred in 1877 and 1879 throughout most parts of Ireland. The English rainfall in the first and second quarters of 1879 and 1880 was specially abundant; it reached nearly 10 inches over an average; 3 inches of rain repeatedly fell within twenty-four hours, producing disastrous summer floods. The number of rainy days was increased, the amount of sunshine diminished. These unusual meteorological conditions have exerted untoward effects on the health of live-stock. Wet lodgings are detrimental both for man and beast. The land, supersaturated and chilled, produced coarser and rougher herbage; the finer grasses languished and were destroyed; fodder and grain were imperfectly matured. Although thus inimical to the higher animals, the excessive moisture favoured the development of a lower order of beings. Mould and ergot have extended amongst plants. Bronchial filariæ have been unusually prevalent among both young cattle and sheep. Still more notably flukes — *Fasciola hepatica* — have multiplied, and distributed themselves, producing liver-rot. The heavy clay soils, imperfectly drained, and land subject to frequent flooding even in dry seasons, furnish occasional cases of flukes in the liver. The parasitic breed is thus preserved. With the droppings of the sheep, the eggs, especially during the spring months, are spread on the grass. A wet furrow, a springy spot, or the neighbourhood of a stagnant pool, affords suitable hatching-ground, and a fitting nursery for the earlier stages of the fluke. With "water, water everywhere," the embryo flukes by and by find abundance of the slugs into which they make their way, are lodged, and, during winter, pass safely through one of their transmigrations. In many localities slugs, both grey and black, during the last two years, are stated to have been unusually numerous; the flukes and their molluscan hosts multiplied enormously on the soft, soaked, spongy soils; the area of infection was widened.

With these several favouring conditions, flukes developed and spread as they have not done in this country since 1829 and 1830. They have extended over land and amongst flocks which for fifty years have been exempt. They have been carried on

to comparatively dry uplands. The losses have been serious on arable as well as on grass farms. In 1879 it is estimated that in England and Wales three millions of sheep died or were sacrificed from rot. Notwithstanding a diminution of one-tenth in the number of the flocks, equally great losses occurred during 1880, and still continue. These devastations are not confined to sheep. Cattle in many localities are extensively and seriously infested. Hares, rabbits, and deer are also frequent sufferers.

The Council of the Royal Agricultural Society was early alive to the serious losses which this visitation of liver-rot was likely to entail. The Veterinary Committee in May 1880 issued a series of inquiries regarding the prevalence of the disease. Various Members of Council zealously gathered information in their own localities. Mr. J. H. Arkwright, Mr. Richard Garrett, Colonel Kingscote, Col. J. P. Turbervill, and Mr. Charles Whitehead, obtained a mass of specially valuable information, which has been placed in my hands, and is embodied in the subjoined report. A new edition of Professor Simond's paper on Liver-rot, reprinted from the 'Journal,' has been widely circulated. A most important investigation, undertaken by Mr. A. P. Thomas, of the Anatomical Department of the University of Oxford, and still in course of prosecution, has elucidated some facts relating to the complex life-history of the fluke, and forms the subject of an article in the present 'Journal.' My report deals with more practical topics —with the prevalence of the disease in different parts of the country, the conditions amidst which it is found, the manner in which it has spread, and the measures adopted for its prevention and cure.

KENT AND SUSSEX, on their heavy clays and frequently flooded meadows, were formerly very liable to rot. Effectual ditching and draining have of late years rendered many unsound grazings perfectly safe for sheep. Mr. Charles Whitehead, of Barming House, Maidstone, responding to the request of the Veterinary Committee of the Royal Agricultural Society, obtained in May and June 1880 the following valuable information regarding the prevalence and spread of rot in Kent. As elsewhere during the winter of 1880–81, the disease has greatly extended; cattle as well as sheep have been largely as well as fatally affected; rabbits and hares are reported to have suffered; and Mr. James Weeks, Bradbourne, near Ashford, has lost from flukes a number of pheasants kept continually in pens.

Mr. John Tyman, Witherenden Farm, Ticehurst, Hawkhurst, writing to Mr. C. Whitehead, states: "I have lost two cows and four calves since Christmas; their livers were quite rotten;

they had living flukes in them, which had eaten large holes in them. I fear I have one or two others affected. One large pig I killed whose liver was in the same condition. Mr. C. White, my neighbour, has lost some beasts and 142 breeding ewes. Many more farmers in this neighbourhood have lost hundreds of sheep. It seems worse amongst the breeding ewes than with the young sheep. We have a large quantity of brook-land; animals are more affected there than on the upper lands. The cause, we believe, was the wet summer of 1879, the food being continually wet. Ten breeding ewes were taken from 150 last autumn, and put on the high lands. These are now alive with their lambs. The 140 which were kept on the brook-land are all dead."

Mr. Selines, writing from Newenden, Ashford, states: "The losses from sheep-rot in this neighbourhood have in some cases been very heavy. I know farmers who have lost 500 to 1000, and even to 2000 sheep. A considerable proportion of these losses have been among sheep and lambs that have been sent out to keep for the winter into parts of west Sussex and Surrey. Those kept in Romney Marsh during the autumn and winter of 1880 have in most cases proved sound. This I attribute to the porous nature of much of the subsoil, and I also am inclined to think that land reclaimed from the sea retains sufficient saline properties to act as a preventive. With regard to the theory of the embryo fluke being taken up with snails, I am unable to give an opinion; but that it comes from sheep feeding in low and undrained pastures during exceptionally wet seasons is proved by all experience. I have heard of some instances of cattle dying from rot, and the butchers assure me that nearly all the cattle they slaughter have flukes in their livers. I have heard of no horses being affected."

Mr. James Hartridge, Bockingfold, Zalding, states that "in the parishes of Zalding, Brenchley, Horsemonden, Goudhurst, Staplehurst, Smarden"—parishes in the Weald of Kent, comprising an area of about 34,000 acres—"I should estimate the loss at ten to twelve per cent. I believe there are two kinds of liver-rot, the most common depending on the flukes; but early in the late winter many sheep went off rapidly with enlarged whitish livers. This form, in which no flukes are found, is stated by some to be the most rapid in its progress. I have strong reasons for believing that fluke-rot, discovered in time, may be got over, that is to say, by a liberal supply of corn and cake, given well salted, and a handful of salt put down the throat once a week. I am trying this. Great losses result from insufficient keeping, when first affected. The land with us which appears to produce the fluke is wet, heavy land from

which the water is not freely drawn off, or land subject to springs which run down the hill-side and spread, making a quick growth of grass." Mr. Hartridge has grazing land upon which he lost no sheep, while graziers immediately upon his right and left lost a great many, entirely owing to the "lay" or position of his land, by which natural drainage was caused.

Mr. George Neve, Sissinghurst, Staplehurst, writes: "Happily the losses in this immediate neighbourhood have not been very great, but it is most difficult to account for them. There are, however, certain lands which in uncertain years are subject to the scourge, and on these there have been heavy losses. I may instance Finch-Cox at Goudhurst, where Mr. Wickham has lost half his flock of ewes; and River-Hall, at Biddenden, where Mr. Boxall has lost a great many sheep. With regard to the benefit derived from under-draining uplands, a farm at Boughton Malherbe, occupied by Mr. J. Cheeseman, and another at Woodchurch, occupied by Mr. Large, both of which were notorious for rotting sheep, have been almost, if not entirely, cured by under-draining. I have heard of an instance of a horse having died from flukes at Mr. Buckland's, Biddenden; and of a good many cases in which flukes have been found in the livers of fat beasts, but they do not seem to affect beasts so rapidly as sheep."

The same gentleman is a large grazier in Romney Marsh, and further reports: "There were very heavy losses in the lowest part of Wallend Marsh, a district of Romney Marsh. This comprises about 1000 acres, of which I hold about 100 acres. Every sheep has disappeared. It is curious that this land, although only flooded by the rain falling on it, and not being able to get away from its low situation, yet, in occasional very wet seasons, suffers from rot as much as the land flooded by the overflow of the rivers heavily charged with silt. Although it has been found that draining the upland pastures in some instances proves a remedy, yet under-draining these low lands has had no good effect."

Mr. Charles Whitehead reports that upon the greater part of the Romney Marsh proper there has not been any great loss from liver-rot among the sheep which have been wintered there. Among the lambs, which are sent away to various parts of the county about August, to return in April to the Marsh, there have been great losses from fluke-disease, contracted, no doubt, in other places. Romney Marsh owes its immunity from rot to its having been drained. Upon a small portion liable to be flooded the losses have been very excessive, but this has been only upon about 2000 acres out of 50,000 acres.

Mr. Walker, of New Romney, writes: "I am not aware that

any rot has appeared in the marsh, except among the sheep and lambs sent away in the autumn and returned in spring, and the loss among these is frightful. Individually I have little faith in the snail theory. I had not heard of any authenticated cases of cattle or horses being affected by the rot."

Rot, although not so prevalent in Mid-Kent, has here and there caused serious losses.

Mr. James Croup Hatch, of Lenham, Maidstone, gives the following information:—"Never until this year have I had a rotten sheep, but since last Christmas I have lost some 30 breeding ewes with this disease. As I usually shear nearly 2000 sheep and lambs annually, this mortality is not, of course (*pro ratâ*) a very large affair. I believe my sheep contracted the disease on a piece of naturally wet, but drained, pasture about the end of November. I have no symptom of it in any individual of my flock, except the ewes that were feeding on the land in question. I sold about 30 refuse wethers at Maidstone Fair on October 17th, 1879, which I am told have all since died with the disease; but these must have contracted the disease after that date, as they were then drafted from some 300 others, every one of which is now perfectly sound, and being fattened upon my best land in Romney Marsh. Many sheep were lost in this neighbourhood from rot in 1860; fortunately I had then not one diseased. In that year I purchased some ewe-tegs from a friend in East Kent. I had them delivered, and mixed them with my breeding-flock on October 21st, and they all proved perfectly healthy, although the whole flock they were drafted from perished from rot. I am of opinion," Mr. Hatch adds, "that the disease is often contracted later in the year than is usually supposed, and whatever may be the direct cause of infection, I quite believe that debility of the system, produced by exposure of the animals to adverse weather and unwholesome food in bad seasons, will predispose sheep to contract the rot. I have known cattle in East Sussex lost this year from liver-rot. The symptoms are precisely the same as in sheep."

Mr. C. Whitehead, Barming House, Maidstone, writes: "I do not know of any sheep that had died from liver-rot contracted in this neighbourhood. I bought a lot of 120 tegs from the Weald of Kent in October, which were put on to fatten at once. Soon after January they showed symptoms of being fluked, and they were killed off while their flesh was fit for human food. In every case their livers were honeycombed by, and full of, flukes. I was informed by the person from whom I bought the tegs that 10 very poor ones were taken from them, as not being good enough to send to me, and that these 10 are now alive, and

show no traces of disease. The 120 bought by me went straight to some of the *most dry land* in the county, and were well fed throughout. Could they have contracted the disease *en route* to me as in the cases quoted by Cobbold and Simonds? I have heard of no cattle being affected in this district."

Mr. Louis Collard, Nackington, Canterbury, Chairman of the "Fleece" Farmers' Club at Canterbury, writes: "The valley of the Stour, from Sturry to Sandwich, seems to have suffered most, but even here it has not been general; many flocks escaping entirely, while others have been nearly decimated. The disease seems to have been contracted in different cases at different times; some quite early in the summer or spring, whilst others did not take it till just before fine weather set in in the autumn."

Mr. Bradbury Tassell, of Canterbury, says: "One of the greatest sufferers I know of here is Mr. Robinson, of Wingham. He estimates his losses at 500*l.* I do not think that high enough. He has also lost two or three beasts. I have heard of one or two colts being fluked; they were at St. Nicholas, near Margate, and had been in the Reculver Marshes. Mr. Robinson's sheep had been in Minster Marshes, where the losses generally were great."

SUSSEX.—*Lord Chichester* writes that fluke disease has been very common in Sussex. His own and other Down farms have, however, escaped.

Mr. H. Rigden, Lyminge, Hythe, farms about 800 acres of old pasture, with 200 arable, and usually keeps 5000 sheep. He bought a farm which rotted most of the flock when the season was wet; it has been thoroughly drained; and, although heavy losses occur all round, not a sheep of Mr. Rigden's has suffered. He insists that "wet is the cause of rot; low, wet, springy spots will produce it, even although the greater portion of the land is sound. Heavy stocking favours its production, for the sheep are forced to feed off the low wet places which would otherwise be avoided. Many beasts in Sussex have been fluked; hares and rabbits are liable, especially the latter. On the wet places referred to snails are always present, but I am not aware of their perceptible increase; there is, however, an extraordinary decrease in the number of birds. September and October are the months during which suspicious wet lands are most dangerous. Three or four months probably elapse after the embryo fluke is taken up before the sheep suffer in health; but the effect will be hastened or retarded by the amount of flukes taken up, the condition and health of the sheep, and the nature of the feeding." Salt, iron-salts, and gentian act, Mr. Rigden concludes, as tonics, but do not stop the disease.

HAMPSHIRE.—On the wetter heavier lands in Hampshire thousands of sheep have been affected. The general impression appears to be that more were attacked, died, or were cleared off in 1879 and the subsequent winter than since. Last summer's census certainly shows a falling-off of 40,000 sheep throughout the county. Profiting by sad experience, extra care last year has been taken to keep the flocks off suspicious land. A few beasts have been affected, but apparently not nearly so many as in the Midland counties. *Major-General Sir Frederick Fitzwygram*, Bart., Leigh Park, Havant, farming 800 acres, part of it tenacious clay, but all well drained, lost during 1879 about 150 sheep, chiefly ewes, but many more were affected; occasional sheep killed from time to time demonstrated that all the flock excepting the lambs had flukes, and they were accordingly made the best of. The lambs weaned early, penned on the clovers and best and driest pastures, and regularly receiving a little cake and corn, have kept sound. Even those lambs whose mothers, emaciated by rot, died at their birth, or shortly after, have shown no evidence of flukes.

Mr. George Hodder, Waites Court, Brixton, ISLE OF WIGHT, manages for Miss Arnold a farm of 300 acres, of which 70 are old pasture, 30 low-lying meadow; the pasture and meadow are on stiff clay, undrained, but none of the farm is liable to flooding; 30 acres are in Down, 170 are dry sandy arable; 200 Down ewes are kept, and their produce usually finished out. They are described as run over the various pastures, they are often folded at night on the arable, and in winter are penned on roots. A few fluked sheep occur every year; about 20 were attacked in 1877, but the whole of the ewes, to the number of 200, were affected in 1879, and in spite of extra care a good many bought in suffered in 1880. In ordinary seasons, Mr. Hodder states, sheep get rot between August and November inclusive, but in such wet seasons as 1879 they take it earlier. He entertains the somewhat peculiar opinion that sheep put into a rot-producing field for a few weeks are more apt to contract the disease than sheep grazing upon it continuously throughout the season. He states that in February 1880 he had lambs six or eight weeks old whose livers were full of small flukes. Their mothers were rotten, and although feeding on grass, swedes, hay, and oats, gave little milk. Mr. Hodder furnishes the following account of his 200 ewes. "Fearing the wet season, I kept them on the down and a few healthy pieces of pasture through the summer. The weather being dry in October I put them on aftergrass in a meadow, folding it over some of the time; they had hay, remained there about a fortnight; no rain fell the while; they improved in

condition. About December 15th I found, however, that they showed symptoms of rot, or cothe as we call it; their time was up for lambing in about three weeks, but they all dropped their lambs nearly a fortnight before their time. I have always found sheep that are badly cothed do this. Not a ewe was lost, or scarcely any lambs, but the ewes, although I kept them well, got very weak and gave little milk. Both ewes and lambs soon began to die, till I had lost nearly half the ewes. Selecting two ewes that we thought would die in about two days, I gave them some medicine to see what effect it would have on the liver. Both agreeably disappointed me; they gradually got over it, and I have them now. As soon as I could get the lambs away from the others they all had some of the medicine, and I lost no more, but shall fat them out this autumn. I had 100 young sheep feeding all the summer on some very wet and unhealthy pasture joining the meadow that rotted the ewes, but not one of them was cothed, although they had no hay in the autumn. Hay given on land liable to rot sheep frequently saves them; those that do not get it, or will not eat it, always die first."

WILTSHIRE.—In the lower parts of Wiltshire many flocks suffered from rot in the autumn of 1879 and subsequent winter; great mortality occurred amongst sheep on the flooded meadows around Salisbury; *Messrs. Rawlence and Squarey* state (November 1st, 1880) "that in some of the grazing districts on estates managed by them scarcely a bullock is killed that has not flukes in the liver; but Mr. Thomas Aubrey, M.R.C.V.S., of Salisbury, informs me that there are now (February 19th, 1881) in his district fewer cases of rot in sheep and none in cattle.

Mr. James Rawlence (a Member of the Council) has brought under the notice of the Veterinary Committee several unique and interesting cases of house-fed calves, suckled by their dams or receiving only milk, killed for veal when under three months, and found to have flukes in the liver. *Mr. Frederick Best*, butcher, Andover, describes his discovery of flukes in a calf killed by him early in May 1880. It was bred by Mr. John Read, of New Court, who declares that he sold it to Best when nine weeks old, that it was fed only on milk, and, until it went to the butcher, that it had never left the house. When killed, Mr. Best states that "he took out of its liver fifteen to twenty flukes about the size which we find in sheep, not being so large as those in a bullock, and of a much lighter colour; they were in the ordinary pipes of the liver, not having worked through them enough to make the liver knotty, as in cases of longer standing. The fat round the kidneys was dull and shrunk, as if the animal had been going back in condition; the veal generally was of a brown colour

and flabby, not having the clear bright appearance of ordinary healthy veal. I showed the liver to two butchers in Andover (who can vouch for the truth of my statement), and they both said they had never seen such a thing before and were very much surprised at it. I did not show it to anyone else, as I did not wish a talk made about it, as there has been so much said about diseased meat that my shop would have been looked on with suspicion, but I doubt if any butcher, with any considerable amount of business, has passed this last winter without having a great many unsound animals through his hands."

Mr. Richard Pike, butcher, Stour Probost, certifies having killed in May 1880 two calves, and finding flukes in their livers. Mr. Aubrey, Veterinary Surgeon, of Salisbury, corroborates the fact, and sent portions of the livers and some of the flukes to Professor Simonds. Being appealed to for further information on the subject, Mr. Aubrey forwarded to me (February 19th, 1881) the following letter:—

"I can speak most positively as to those two livers I examined for Mr. James Rawlence. In the first the flukes would not have been discovered by a casual examination, as I failed to find them by opening the large biliary ducts, but upon cutting the liver in thin slices I found two well-developed flukes, in fact divided them in the act of cutting, and Mr. Newton (a pupil of Messrs. Rawlence and Squarey) was present at the examination. In the second case I also found two flukes in one of the large ducts, but I understood the butcher had removed several others before. Of course I know nothing of the history of the animals, but the livers appeared to be from calves about five or six weeks old; the weight of one was $4\frac{3}{4}$ lbs., and I could not detect any alteration in the structure of the gland. I had no opportunity of examining Mr. Read's calf at New Court, Downton, but I saw its mother, which was an Alderney cow, in perfect health, and I found that the shed where the calf was reared was in close proximity to a pond between two pastures, and from which the cow drank daily, and I think it very probable, as I suggested to Professor Simonds, that she got some of the penultimate forms of the fluke at the pond and the calf licked them off her. I forwarded some of the pond water to Mr. Simonds, but did not hear the result of his examination."

Bearing on this subject *Mr. Joseph Stratton*, Manningford Bruce, Marlborough, communicated to Mr. James Rawlence, particulars of a white steer:—

"Calved April 30th, 1878; never out of the house since his birth; the only green food he ever tasted was a small quantity of grass taken to him for only two or three weeks last summer,

the same being grown on peculiarly dry pasture-land just adjoining my rose-garden. Judge my surprise to find when he was slaughtered (June 18th, 1880) that he had a considerable number of flukes in his liver. I may add that the mother is my best roan cow, and took the first prize at this year's Marlborough show."

An analogous case of flukes occurring in a house-fed calf is communicated by *Mr. George Lepper*, of Aylesbury. Two similar cases in the spring of 1880 were met with near Stratford-on-Avon. The calves, under ten weeks old, were from two different farms, and are stated not to have been out of the pens, and to have been kept entirely on milk, with latterly a little flour. A still more extraordinary case is communicated to Mr. Rawlence by *Mr. T. Munckton*, Petersham Farm, Wimborne, who states: "In May 1880 I had a heifer-calf which when born was very weak, and after a few hours died. Having had it opened, I found two flukes in the liver. It never stood or sucked at all." Such a remarkable case demands, however, corroboration. Not all the creatures hastily or ignorantly set down as flukes are so in reality. Cestoid worms, and even flakes of lymph or mucus, have not infrequently been mistaken for flukes. In Leicestershire the other day I saw some cestoid worms erroneously labelled "flukes from the liver of a horse." There is no sufficient evidence of tapeworms or other parasites being congenital.

A still better authenticated case of flukes discovered in the fœtus has been recorded by *Mr. George Evans*, M.R.C.V.S., Wells. Replying to inquiries made by Mr. Rawlence, he wrote to him (November 8th, 1880):—"I have found flukes in several instances in the livers of calves and lambs at birth and immediately after. I was called to examine a flock of ewes in dispute sold with a warranty, several of which died. I made a post-mortem examination of three, two of which I had slaughtered for the purpose; their livers were literally crammed with flukes. Opening the lambs, I found the livers much enlarged, and several perfectly formed flukes—I cannot say how many, but numbers of them. I have also found them in calves that have died a few days after birth, and it is not uncommon to see them in the livers of calves killed for veal that have been fed on the stage and never been to grass. In one particular case the cow was down for some weeks before calving, evidently suffering from liver-disease; she produced a dead calf, very emaciated, and in its liver I found flukes. The cow died, and her liver contained a quantity of flukes. I shall make further observations and report to you regarding such cases. Hundreds of sheep are dying from rot in my

district, and on one farm alone seven cows died in one week from diseased liver. I did not in these cases examine the calves."

Evidently in these cases of flukes occurring in lambs and calves at birth, or immediately after, the cercarian forms of the fluke have been picked up by the dam, probably during the latter half of gestation. Carried in the blood, instead of being deposited, as is usually the case, in the maternal liver, they must have passed, as the mother's blood freely does, into the fœtal circulation, and been arrested in the liver by that unexplained affinity which certain organs exert over both normal and abnormal blood constituents. Little more than a month's location in the fœtal as in the adult liver would bring the immature flukes to the full perfection in which they have been found by Mr. Evans and a few other observers. These cases of congenital parasitism must, however, be extremely rare. Hundreds of lambs dropped from ewes in the last stages of rot have been examined without finding any traces of flukes, of ova, or of other embryonic forms. Thousands of lambs and many calves from fluke-infested ewes and cows, thrive and grow without any manifestation of fluke infestment. Calves or lambs do not swallow, as has been popularly supposed, fully-developed flukes, and, judging from experiments made by Professor Simonds, Gerlach, and others, adult flukes, even if swallowed, produce no effects.

The ultimate host, be it ruminant or rodent, young or old, appears to swallow the immature cercariæ in their encysted form. Within five or six weeks, some authorities say within a month, these cercariæ may pass to the liver, and become fully-developed flukes. In the authenticated cases mentioned by Mr. Rawlence and other observers, occurring in house-fed calves of eight or ten weeks old, there was thus ample time for infestment in the usual manner after birth. Neither calf nor lamb can get the parasite in the milk as yielded direct from its dam. There is no evidence of cercariæ passing from the blood into the milk-gland and thence being secreted in the milk. The calves and other juveniles doubtless swallow, as their dams might do, the cercariæ whilst nibbling a morsel of cut grass, clover, or cabbage, on which the parasite form is lodged. The water used to wash or swill milk-buckets may contain and leave in the buckets some of the penultimate forms which may be taken by the calf in its next meal of milk. Perhaps more probable still, the cow or ewe lying on the pasture, or straying through it, or drinking from a stagnant pool, gets attached to her skin or wool these cercariæ, which thence would be readily licked up by the calves or lambs, and in a few weeks matured flukes would be found in the liver.

Dorsetshire presents the same sad story as other southern and midland counties. *Lord Portman* certifies that many Vale farmers have lost all their sheep and many cattle; that sheep on the hills are, however, fairly sound, but that even amongst them a few flukes may be discovered preventing their being warranted.

Mr. George Turner, of Great Bowley, Tiverton, writing in May 1880, stated: "I am sorry to say that quite two-thirds of the sheep that were alive at Michaelmas last, through the whole of the Vale and larger part of Devonshire are now gone, many having died, and the remainder being sold at 10*s*. to 15*s*. a head, slaughtered, and sent for the most part to London. The butchers also tell me that a great number of the horned cattle have flukes in their livers, and in this neighbourhood many young ones have died completely rotten. The learned professors have told us a good deal about rot in sheep, and also black leg or quarter evil in cattle, but have failed to inform us how to cure or even prevent them. More sunshine and less rain will prevent the rot in sheep, and I can tell them how to prevent quarter evil in calves."

Sir T. Dyke Acland, Bart., M.P., responding to the inquiries of the Veterinary Committee, in May 1880, stated: "We have had great losses by sheep-fluke, or by what is generally called rot or caw in Devonshire and Cornwall. On my farm in Broad Clyst, five miles north of Exeter, I had to sell the whole of my 200 breeding Devon long-wool ewes at a loss of about 500*l*. or 600*l*. I fear several of my neighbours lost many of their sheep from a similar cause. Several farmers with whom I am connected, between Holsworthy and Bude, lost a number of sheep last year. I am unable to say whether the cause were flukes. I believe the Exmoor sheep on the hills have been, comparatively speaking, unaffected. I have heard rumours of injury to bullocks from the fluke, but I am not able to speak accurately."

On the lighter lands, in the neighbourhood of Plymouth, the losses have not been so widespread and serious; but on the heavier wetter lands of North Devon great mortality has occurred. In the Holsworthy district 7000 sheep had died up to Midsummer 1880, entailing a loss estimated at 11,000*l*. Around Oakhampton and Launceston similar disastrous results occurred. On the Cornwall vale-lands heavy losses are reported. In one small parish of Landrake seven occupiers, occupying only a moderate area, lost sheep to the value of 1000*l*., and fears are generally entertained that none of the heavier wetter lands are now safe for sheep.

The Eastern Counties, with their lighter rainfall, have not generally suffered so seriously from the recent visitation

of rot as the moister Southern or Midland Counties. Essex farmers frequently keep a flying flock, and, even if infected with fluke, the sheep are not usually long enough on hand to suffer seriously. The heavy clays around Romford have not contributed either rotten sheep or cattle. On the tenacious land at Havering Park, the chief losses of the past two years have been a few lambs choked with bronchial filaria.

Mr. James Ross, The Grange, Hatfield, states that in his own neighbourhood and in the district around Harlow, sheep have also been fairly healthy. He continues that he never wintered sheep with less loss than in 1879–80. "We had 150 ewes put to the tup, and I sold out, May 10th, 1880, 148 ewes and 200 lambs. We lost thirteen small lambs early in February. My sheep were wintered on sound well-drained pasture, with a liberal allowance of dry food, with cotton-cake, and in severe weather a few split beans or maize; the food is always regulated according to the severity of the weather. Flukes in sheep I remember for fifty years in wet seasons, but many years careful observation satisfies me that many farmers do not manage their live stock during the winter with care and proper food, which certainly prevent rot both in sheep or cattle. Although preventible, when once established rot cannot be cured."

Mr. F. Whitmore, Secretary of the Essex Agricultural Society, writing July 5th, 1880, stated that around Chelmsford, and thence as far down as the Tendring Hundred, no liver-rot has occurred either amongst sheep or cattle.

SUFFOLK.—On the heavier lands of East Suffolk rot was noticeable early in the autumn of 1879. Around Woodbridge and Saxmundham extensive and crushing losses occurred. Very generously, Mr. Richard Garrett, of Carleton Park, and an influential committee, in the spring of 1880, raised subscriptions in aid of the more needy flock-masters; nearly 2000*l.* was collected before midsummer; claims for the loss of upwards of 4000 sheep were sent in for consideration. Notwithstanding the restricted flocks, many of which could not be replaced, extensive losses have continued down to the present date. Mr. R. Garrett, losing some sheep and finding flukes in the livers of others killed for the purpose of investigation, after much deliberation parted with his valuable flock of 500 black-faced Suffolk ewes. Other flocks of repute, to avoid heavier losses, have also been disposed of to the butcher. The Sudbury district, on drier lighter land, *Mr. H. F. Jennings* informs me, has hitherto kept clear of liver-rot. *Mr. Alfred J. Shorten*, M.R.C.V.S., of Ipswich, has sent me the following interesting letter:—

"I have had few opportunities of inspecting the livers of

lambs born of ewes affected with rot, but my examinations have failed to discover any flukes. Mr. R. Garrett, of Carleton Hall, had several cases of rot in shorthorn heifers during the spring of 1880, but I have not heard of others in this neighbourhood, though I have been told by butchers that it is not uncommon for them to find flukes in the livers of beasts when slaughtered. I have asked to be allowed to see any cases of this kind, but at present have not been favoured with the opportunity of an examination. With regard to your inquiry as to the exemption of individual sheep in a flock, I cannot give a positive answer, as the opportunities of postmortem examinations of sheep at a distance from home are necessarily restricted, and the disease has not been rife amongst the flocks in this immediate district; but my impression is that it is very exceptional for any individuals in a flock to escape, provided they have not been separated at an early period of the summer. I have not examined the livers of hares or rabbits, and am therefore unable to give information; nor have I heard of or seen any cases in horses. From observation of Mr. Garrett's and another flock, I am inclined to consider that the month of July and latter part of June is the most usual time when the disease is contracted. In many cases only a short period is required for the manifestation of symptoms of rot. In illustration I may mention that, on 30th July, 1879, I was first requested to visit Mr. Garrett's ewes, as several had shown symptoms of something being wrong, *i.e.* they were spiritless, and not doing well. On examination I found the conjunctival membranes pale and watery-looking, the wool harsh and dry, and a general unthrifty appearance; but rot not having at that period been seen or suspected, I hesitated to pronounce them so affected. However, we slaughtered two or three of the worst-looking, and found the blood to be thin and watery, with little disposition to coagulate, the tissues generally pale and flabby, and but little adipose deposit; with no actual disease of any of the viscera, though the livers were not so firm as they would have been in healthy subjects; but no flukes were discovered, and no dropsical effusion in the abdomen. Notwithstanding the absence of flukes, I bore in mind the wetness of the season, and advised the sheep being treated with a mild aperient, followed by occasional doses of oil of turpentine; and to have salt and sulphate of iron mixed with their food, which was to consist of ground oats, bran, and bean-meal, with hay-chaff, and to be kept on the uplands where they were when I saw them, though they had previously been on Carleton Park, where there is boggy land. I determined in my own mind then that the sheep were affected with rot, and though I continued to receive reports from Mr. Garrett, and also

from his steward, that the "sheep were all right and doing well," the sequel has proved that I was right. The animals, however, went well through the lambing season, and produced a good fall of healthy, strong lambs, with a loss of less than 3 per cent. of the ewes. The livers of those dying were generally examined by Mr. Garrett's steward, and found to be greatly infested with flukes. This account somewhat militates against the received opinion that rotten sheep thrive at first; but the above facts nevertheless remain. This appears to me to be a very critical time with flock-owners, for this reason amongst others. Affected ewes now discharge the flukes which have completed their ordinary term of life, and accomplished their mission of reproduction by emission of their ova. The sheep, moreover, are in danger of recontamination by the cercariæ produced from the ova of last year's parasites. Where is the mischief to stop? If we have a continuance of wet weather, there is imminent danger of the disease being increasingly prevalent. Of what use will it be for the farmer to kill or sell off his present flock, and buy fresh sheep to introduce to the affected sites? This is a serious question, and demands much consideration."

NORFOLK.—Writing from Brettenham Manor, Thetford (Feb. 22nd, 1881), *Mr. J. Ferguson* reported that in his district thousands of sheep have been made away with in consequence of the rot, and farmers in increasing pecuniary embarrassment consider it better to say nothing about their losses. "I keep," he continues, "from 1400 to 2000 sheep. My farm—with the exception of about 140 acres of low meadow—is high and dry, too dry; and on my low lands I never allow any sheep except crones to run.

"Last Michaelmas I purchased at a sale near here 160 sheep. After having them a few weeks I had doubts about them, and had some killed; they were full of flukes; the rest of the lot were fatted and sold to a butcher, who told me that the whole lot were rotten. I may say that these ewes were kept on high and dry land of good quality, where no floods could possibly happen, and where sheep were never known to rot.

"The snails that are supposed to cause the rot can be seen in any quantity on the marshes near Lynn; they are the shape of an ammonite, and in size from a threepenny-bit downwards.

"A neighbouring butcher told me the other day that he kills but few bullocks now without finding flukes in the liver. I had some young cattle and a mare and foal on my low meadows during the summer of 1879, and in the spring of 1880 I lost a heifer and the mare. The former was perfectly rotten, and I believe the mare also, as she died very unaccountably; but unfortunately we did not examine the liver. A dealer in this

part of the country is positive that lambs take the rot from their mothers before they are dropped.

"I always give my stock plenty of rock-salt and dry food; am now feeding my 800 ewes on beans, bran, sainfoin-hay, chaff, and swedes, and my hoggs on swedes, cake, and pease, and a little chaff."

On Lord Leicester's estate at Holkham, *Mr. Samuel Shellabear* stated that the outbreaks can all be traced to flooded or wet unsound land, often requiring draining. Many of the infected sheep have been run on salt marshes. These, however, have not been the source of the rot, but the occasional or frequent grazing upon them has not afforded protection against rot, or arrested its development either in bought sheep or in those which have picked up flukes on the adjacent upper marshes. Mr. Shellabear further mentions that, whilst every effort is being made to dry the rotten pastures, anxiety is expressed as to whether other means cannot also be used to prevent the disease being spread by infected animals.

Mr. Edward Nelson, Warham, Wells-by-the-Sea, out of a flock of 300 black-faced ewes, since October 1st, 1879, has lost 250; but the small crop of lambs which he got has hitherto escaped. The specialty of his case consists in his having 450 acres of salt marshes which are overflowed twice daily by spring tides. Previous to 1879 there had been no cases of liver-rot on the farm. Mr. Nelson reported: "I have lost 250 home-bred sheep, being nearly all my ewe flock, since October 1879, but never before heard of rot on this farm. My cattle are affected, but although doing badly none have died; I have not known horses attacked. I believe two months elapsed from the grazing of the sheep on the wet meadows and their becoming evidently rotten. I found doses of salt, sulphate of iron, and stimulants strengthen the sheep for a time, but without much permanent good—they all died."

Mr. Nelson further stated: "I do not for one instant think that my flock contracted the disease on the salt marshes, but on some enclosed meadows over which the salt water does not come. My case seems to prove that salt marshes will neither prevent nor cure rot, as sheep were running on them at least five hours a-day at the time they became affected. From October 1st, 1879, my flock of 300 ewes went on the salts every day, when the tides allowed, from 6 o'clock A.M. till noon, when they came on the enclosed marshes for one or two hours, always going to the high arable lands at night; this course was followed till November 30th, when they were kept entirely on the arable land. I think there is no doubt that they got the embryo fluke on the enclosed fresh marshes—first, because none of my neighbours' sheep,

feeding on the salts joining mine, were affected; and, secondly, because nearly all my bullocks, feeding on the same enclosed fresh-water marshes, when killed had a great many flukes in their livers. Two months seem to elapse between taking up the flukes and the first appearance of disease. My first sheep died on December 10th, 1879, and from that time they kept dropping till, on October 1st, 1880, I had only 50 left. The 300 ewes produced very few live lambs, but they were very healthy and showed no sign of disease when I sold them in September 1880. I kept the 50 ewes I had left, and they are now fat, with the exception of two which I had to kill and which were very full of flukes. You ask what is the usual health of sheep on salt marshes?—I have always found them very healthy and very seldom is there any loss from death, but they are always in very low condition if they depend entirely on the salts for food."

Mr. Alfred N. Leeds, of Eybury, thus wrote regarding the Peterborough district: "Wherever sheep have been put on the meadows of the Nene Valley they seem to be affected with flukes; and great numbers of both ewes and fat sheep are suffering on land where rot has never been known before. Ewes seem worst affected; but I have heard of several flocks of half-fat sheep that have had to be slaughtered. I have seen several of our principal butchers on the subject; they have never known unweaned calves or lambs affected. Lots of rabbits and some hares are attacked. Beasts that have been on the meadows are affected; but in their case the flukes are encysted often in a sort of hard shell, and the beast continues to thrive fairly. I have not heard of any beast dying from fluke. Six months on dry food in the yard may be the saving of them. Where flukes were not known before it is on very wet badly drained land, sometimes on fen-land, that they have appeared. Some people say large quantities of ground maize enable sheep badly affected to get over it. My own idea of this neighbourhood is that no one knows whether he has sound sheep or not. I have never seen a sign of it among my own; but it would not surprise me to find it; it has cropped up in so many unexpected places."

LINCOLNSHIRE.—*Mr. Shuttleworth*, of Lincoln, considers "that his part of the country has been most favourably dealt with, no case of disease having occurred. During the winter of 1880–81, the Grantham district has continued to furnish to the Midland and Metropolitan markets thousands of sound sheep and cattle." *Mr. James Martin*, Wainfleet, considers that the Grimsby neighbourhood is the part of Lincolnshire which has suffered most seriously. "The disease," he states, "may be ascribed to the same causes as the agricultural depression, namely, wet and

ungenial seasons, aggravated by negligence in not having the lands thoroughly drained. The farms on which the great losses occurred have not been properly ditched or drained, and are in a lost state. . . . . It seems to be pretty generally understood that the remedy is in the hands of the owners of the land, that is to say, very little fear need be entertained of a recurrence of rot if they carry out a proper system of drainage."

Mr. Henry Sharpley, Louth, Lincolnshire, writing February 14th, 1881, said that "more rot is showing itself in this district than has yet occurred; it is now found in flocks that at Christmas were believed to be perfectly sound. It is, however, chiefly confined to the wet, undrained, or flooded middle marshes, and mostly attacks sheep kept upon them late in the autumn. Even in recent seasons when it was so rife elsewhere, rot was unknown on the sea or salt marshes as well as on the hill or wold land. Few of the uplands, even of heavy clay, have furnished cases. In this part of the country second-year's seeds on wet low lands, in dripping seasons, are believed to be generally prolific of rot."

Mr. D. Gresswell, M.R.C.V.S., of Louth, on February 11th, 1881, reported as follows:—"Rot has not existed in this district for forty years to my knowledge before the latter end of 1879 and the beginning of 1880, and then only in three parishes of low-lying or undrained middle marsh-lands, where it has been very fatal. In the latter part of 1880 and beginning of 1881 it has not been so bad as it was the year before; but I think we do not yet know the worst. The sheep generally got the disease last September and October; the flukes in livers which I have examined about a fortnight since were very small; as they get larger the health of the sheep will suffer more seriously. The disease does not appear to have been brought to these parts; it arises purely from the land being flooded. I have only seen it in Lincolns; we have no other breeds in the neighbourhood. Rot is not an infectious disease; it never occurs on the wolds or chalk hills. Rotten sheep taken to the wolds may all die, but those they are mixed with I have never known to become affected. I have never seen rot or heard of it in the salt marshes. I do not believe that land becomes impregnated with the germs of rot, although sheep may be dying upon it; unless again flooded it will not produce rot next year. This, I know, is contrary to the general belief. But if land could become tainted with the germs of this disease, we should have it on the same land for several successive seasons; whereas it is generally known to exist for one season and then cease, except when the land has become flooded again. The year before last we had a tremendous lot of lambs suffering from tapeworms, but none before on these lands. Many of the

worms measured by myself were 20 feet long; that was in the months of May and June 1879. There would be at least three joints in each, and 50 eggs in each joint, the quantity of eggs voided must amount to millions in a field; but the same land in 1880 did not affect the sheep with tape-worm. Then, again, how is it that in the summer of 1879 thousands of lambs in this district became affected with the throttle-worm, and the same lands scarcely affected the sheep at all in the summer of 1880. There must, hence, be some special law in action in certain seasons favouring the development of these worms."

Mr. C. W. Tindall, Aylesby Manor, Grimsby, manages 1700 acres, two-thirds arable, one-third pasture, the land being high wold, loam, clay, and marsh. About 1000 Lincoln sheep are kept, grazing on the old pastures and clovers in summer, folded on turnips in winter, receiving besides cake and other concentrated food; salt has been used since 1879. Certainly for half a century the farm has never rotted sheep; the marshes are not liable to flooding, but for several months during the summer of 1879, owing to the continuous rain, they were in places ankle deep in water. The cattle as well as the sheep grazed there between July and October have been fluked; 400 ewes were affected; some are stated to have suffered earlier and worse than others; but the aggravating circumstances are not known. Mr. Tindall is unaware whether the hares and rabbits are affected with flukes. The following is his statement of the Aylesby visitation:—" On August 6th, 1879, we sent from our Wold Farm 190 feeding ewes to marsh land in the parish of Immingham, also 180 breeding ewes to marsh land in the adjoining parish of Stallingboro', both very similar land, both lying low. The 190 Immingham ewes came to wold turnips on the 9th of September. For a time they did well, but in the first week in December I found they were going all wrong, and had them examined, when they were declared affected with rot. We ran 10 through the gate and had them killed, and found them as bad as needs be. Consequently we drew 100 of the worst and killed them at home, sending the carcasses to London; the rest we sent off alive to Manchester. This was the third week in December. The ewes that went to Stallingboro' came up on the 6th of December, so at the same time we had them examined, and drew out 10 of the worst-looking, and sent them to be killed. Finding seven of them quite sound, so far as we could tell, I would not let any more be killed. From the above you will notice that the Immingham ewes were down only six weeks and all rotten, whereas the Stallingboro' ewes, under circumstances exactly the same, were down 16 weeks, and at this time were

sound. By the end of January the Stallingboro' ewes began to show signs of rot. In the first week in February I had them examined again, drew out 70, had 15 sent to Wakefield, and 55 killed at home. Finding them as full of flukes as possible, but not so apparently rotten as the Immingham ewes had been, as they only brought slaughtered 29*s.*, and three-fourths had pairs of lambs in them, I determined to try the rest, and killed no more. We sent them back to turnips, giving them 1 lb. of linseed cake, and as much cut barley in the straw as they could eat, along with salt, iron-salts, &c., as recommended by Professor Simonds. We never lost another ewe; they brought first-rate lambs, and are alive to this day: thus showing that flukes need not kill them. I have come to the conclusion, though we lost nearly 400, we need not have lost any, had we persevered with them."

Mr. William Frankish states that "fluke has done considerable damage in the neighbourhood of Ulceby, but cattle and horses are understood to have escaped. Many farmers here as elsewhere, by the death of one or two sheep or the slaughter of others, when they found that their flocks were infested with flukes, sold off what were fit for the butcher, but determined to take their chance with those which would have realised only 'a skin price,' put them on dry food, were particularly careful in management and feeding, carried many of the ewes through the trying periods of lambing and nursing, and saved hundreds of hoggs probably more or less infected with fluke."

Berks and Oxon.—The valleys of the Thames and of its numerous tributaries, since the summer of 1879, have proved prolific nurseries for the development of flukes. From Richmond away beyond Oxford, and onwards amongst the higher reaches of the Isis, sheep, cattle, hares and rabbits have been infested. The tender water-logged meadows, owing to their wet cold state, are not only deteriorated for feeding purposes, but until a roasting summer occurs to dry the land and destroy the various phases of fluke-life, they will continue to rot ruminants grazed upon them. Their produce of coarse silt-befouled hay is moreover liable to convey the cercarian forms of the fluke to sound flocks. Around Slough, Henley-on-Thames, and Reading, great mortality from fluke has occurred. Large sacrifices were made of flocks in the autumn and winter of 1879; several relays from sound localities purchased to replace the earlier losses have since followed. *Mr. J. Druce*, of Eynsham, Oxford, referring to the Resolution of Council in May 1880, has reported that "very many flocks all through the Valley of the Thames, commencing at Abingdon, Berks, to Crickdale, Wilts, and on the tributary streams thereto—such as

the Cherwell, Evenlode, and Windrush—liver-rot has been very prevalent, and most disastrous. Although willing to assist in investigations relating to the cause and prevention of the disease, none of the sufferers seem to be in a position to give definite information."

The following interesting letter has been forwarded from Mr. Henry T. James, M.R.C.V.S., Oxford:—"Flukes have been very prevalent in this neighbourhood. Not only have their ravages been great upon the wet and low lands, which are known to be subject to rot in wet seasons, but they have appeared on lands never known to have been productive of the disorder. Some thousands of sheep have succumbed, hundreds have been saved by nutritious food, and the ewes have been able to bring forth their lambs, and during the summer of 1880 have done moderately well. In cattle, although the disease has been prevalent in many localites, it has not assumed such a severe form as in sheep, neither has it proved so fatal; one or two in a herd have succumbed; the most that I have seen together has been five in a herd of nearly a hundred; those remaining are mostly improving. It does not appear that cattle are so susceptible as sheep. In the horse I have not seen one single instance."

On the Oolite stone-brash, the drier land between Chadbury and Chipping-Norton, liver-rot has been less frequent and serious; but on the lower-lying meadows extending from Oxford to Banbury, and thence to Fenny Compton, great and reiterated losses have occurred; while from the wetter lands by brook and river the flukes have extended to pasture and clover-leas, which two years ago would have been regarded perfectly sound.

Buckingham, with its large proportion of retentive clays, and its flat, flooded, or water-soaked meadows along the banks of the Ouse and Thame, has contributed a heavy quota to the losses from rot. Reiterated attacks of pleuro-pneumonia and foot-and-mouth complaint a few years ago discountenanced dairying; many farmers increased their flocks; even on the heavier land sheep were expected to pay the rent. Some good breeding-flocks are kept, but on many of the Vale-lands the practice has been to buy in during spring South and West Country sheep, which were generally warranted "all right," and were disposed of fat during summer and autumn. The Vale of Aylesbury, once a worthless swamp; it has been raised to fertility by ditching and draining, but alas! it is now apparently disposed to return to its pristine state. Around Aylesbury, on the plastic clays, to Wootton, Grandin, Marsh Gibbon, and across to Winslow and down the river-banks to Thame, whole flocks both breeding and dry, home-reared and bought, have been swept away. Around Shobbington, Ickford, and Waterperry, not only sheep but cattle

have been badly rotted. On the plastic clays which run north-west through the county from Brill, west of Winslow, viâ Bletchley, to Newport Pagnell, very large and generally distributed losses have occurred. Flocks confined to the gravels, chalks, and elevated parts of the Chiltern Hills, have, however, remained perfectly sound, indicating how closely connected is the prevalence of the disease with standing water and supersaturated soils.

In August 1879, about Aylesbury, Winslow, and Thame sheep begun to fail, and bad livers became common. Often they were congested and enlarged, of a sickly yellow colour, containing small flukes, usually in cysts throughout the liver, but the fully developed flukes were not always free in the bile-ducts, and some of these earlier cases accordingly were not identified as liver-rot. As the autumn grass lost its nutritive value, and the weather became more severe, the mortality greatly increased. Thousands of in-lamb ewes lost flesh, became bottled under the throat, the caruncle of the eye pale and watery, the wool broken and readily pulled out. At any price they would fetch they were generally sold. In several slaughterhouses heaps of immature lambs were piled many feet high. Not one-third of the usual crop of lambs was reared in 1880. The total sheep in Bucks, which in 1877 had numbered 258,805, had receded to 195,764. In partial compensation for this great diminution in sheep the cattle had increased by 5000. Hares and rabbits have generally been infested with flukes; many have been found dead, and some so feeble that they might be run down and caught. Butchers at Aylesbury, Thame, and Oxford, have assured me that few sheep in these districts, unless coming from the higher chalk ranges, are now free of flukes, and that the cattle, unless where they have been early housed and extra well done, are likewise affected. Several cases were mentioned of bulls three or four years old, which had always been in the house, having when slaughtered flukes in the liver. A useful shorthorn three-year-old, belonging to Mr. Abbott, of Thame, was found to have the outside margins of his liver full of encysted flukes, and numbers also occupying the ducts.

Mr. John Treadwell, Upper Winchenden, is one of the few Bucks flock-masters who have escaped without a rotten sheep. It is difficult to determine whether his fortunate immunity results from the elevated position of his holding, its thorough drainage, his own careful good management, or his liberal use of concentrated dry food, and distribution of rock-salt. Such cases of exemption occurring in the midst of infected areas demand careful investigation, and might form fitting material for a subsequent report.

Mr. George Lepper, M.R.C.V.S., Aylesbury, informed me that liver-rot has annihilated the sheep in the Vale. Between Aylesbury and Thame are scores of farms, two years ago carrying flocks of 200 to 300 sheep, where now not a sheep is left. He does not consider that previous to 1879 many of the Vale sheep had flukes, but there must have been parents for the myriad progeny which have since appeared. Protected under hedgerows and tree-roots, and about pools, the eggs and other stages of fluke-life, Mr. Lepper believes, may be preserved for years, and come forth in destructive activity under the favouring influences of summer moisture. In support of this view Mr. Lepper mentioned that in the park at Weedon, a few miles from Aylesbury, which for two years had only been grazed by bullocks, sheep believed to be sound were placed in September. By December those killed for the house were found to be infested, and the whole were cleared off, and reported by the butcher who had them to be "all fluked." From August to November on low flooded lands rot was wont to be looked for, but these two years, Mr. Lepper declares, it has come at any period of the year, and on almost all land. He believes that flukes have been picked up from turnip-tops, on which, by the way, slugs are often found. Sheep run on some of the fluke-infested meadows within six weeks he considers will now show symptoms of disease. But the rapidity with which they are affected is variable. A hundred sheep from the same farm brought to Quarrondine were equally divided between two brothers, and were very similarly treated. One lot began to die in a month, and were nearly all gone before the other 50 showed anything amiss. Lambs three months old Mr. Lepper has known to have flukes, and a house-fed twelve-weeks calf, which had always sucked its dam, killed at North-Marsdon in the summer of 1880, exhibited twelve lively flukes. The mother of this calf was fetched in with the other cows from the meadows night and morning, and doubtless brought to its offspring the dangerous cercarian form of the fluke. While this penultimate form is still in the stomach, turpentine, carbolic acid, and iron-salts, are obviously effectual to destroy the larva. Even in the earlier stages, when the fluke has reached the liver, such medicines, with dry food, undoubtedly arrest development of the fluke and its power of mischief.

Many cattle in Bucks have died fluked, and many more have in consequence thriven badly. Even on the rich-feeding Quorrandine land, supersaturated and soured, as it now is, many young cattle during the winter of 1879-80, left out, as they were wont to be in favourable seasons, pined and died, their livers being full of flukes. Greater pains have been taken this

winter. Rough shedding has been provided, more dry food furnished, and less mortality has accordingly ensued. But such preventive treatment increases expenses. Land which will only carry stock five months out of the twelve, and is even then liable to rot both sheep and cattle, must depreciate in value. Landowners are generally helping their tenants in their difficulties; deductions, varying from 10 to 20 per cent., have been given for several audits. The Duke of Buckingham, I am told, has made good to many of his tenants their losses from liver-rot. Baron Nathaniel Rothschild, determined if possible to strike at the root of the evil, at his own cost, is having large tracts of land thoroughly drained; fully 1000 acres have been thus treated this year and last. It would be desirable that the smaller tenancies and worst lands were taken in hand first. On other Bucks estates draining and ditching are also being extensively done, the tenants usually having to pay a percentage on the outlay.

BEDFORDSHIRE, notwithstanding its large proportion of porous, dry, well-cultivated land, and the varied supplies of dry food furnished to the flocks, has contributed many cases of liver-rot. In May 1880, *Mr. Charles Howard* stated that many losses amongst sheep had been sustained in the county from fluke disease; both cattle and horses had been affected. During the winter of 1880–1881 rot has generally been more widespread and aggravated; dealers and salesmen assert that not many of the ordinary farm flocks can now be warranted sound. To many upland farms hitherto perfectly free from flukes, the parasite has frequently been introduced by sheep brought from adjacent counties, notably from Bucks, Hunts, or Berks; but, unless where the land has been soaked with standing water and the sheep in a thriftless and impoverished state, it has seldom extended amongst the home-bred flocks. In upper Bedfordshire the losses have been heavier during the past year than in 1879. *Mr. J. H. Blundell*, of Woodside, Luton, has no personal experience of rot; his profitable Oxfordshire Downs are chiefly kept on the well-drained arable land in summer on a succession of fodder crops, in winter upon roots; large amounts of dry food are continually used; there is little likelihood of introducing the embryo forms, for only a few tups are bought. For several years Mr. Blundell has observed an unusual number of slugs; the unwonted moisture appears conducive to their development, while the severity of the weather, the low tidily-trimmed hedges, and diminished shelter, limit the proportion of their natural enemies the thrushes and blackbirds. On dry land, where no flukes have been distributed, the slugs, however, cannot be infested by flukes, and hence can have no effect in rotting sheep.

Mr. E. D. Roberts, Selsoe, near Ampthill, farms 1050 acres, 350 being dry chalk and gravel, mostly arable; the remainder is low wet clay-land in about equal proportion of pasture and arable. He has had the farm for thirty-two years and never seen any flukes. The flock varies from 500 to 800; many are bought as stores in spring, grazed in summer on the pastures, in winter on the arable, receiving dry food and salt in boxes. Mr. Roberts lost 260, about half of them young ewes, lambing in 1880, and in high condition. The slaughtering of several made it apparent that the whole were infested. They managed, however, to rear their lambs fairly, but as the lambs got strong several of the ewes died. The lower lands, subject to overflow of brooks, doubtless produced the disease. The weakest sheep suffered first and worst. None of the old pastures, soaked as they are, with water standing in the furrows and low places, are now safe for sheep. No particular plants or weeds have shown themselves in the pastures, excepting blue carnation-grass; the finer and better herbage is, however, gone. The continued wet has increased the number of snails, and especially the small white slug. Thrushes and blackbirds have decreased, rooks and starlings are as numerous as ever. One hundred and twenty beasts from three to four years old have been more or less infested with flukes. Although they did not show any marked symptoms, they did not thrive as they should have done; they died light, and post-mortem examination disclosed flukes and hardened liver. Large supplies of dry food, causing the patients to make blood faster than the flukes wasted it, checked the disease, but few sheep badly fluked recovered. The great remedy must be drying the soft and rotten land, and getting the streams and rivers to carry away rapidly the almost tropical summer rains.

CAMBRIDGESHIRE has not usually suffered so much as some of the adjacent counties, although on many healthy farms purchased sheep have died. In Huntingdon, along the tortuous valley of the slow-running Ouse, from the flooded meadows and low ground about St. Ives, during the past eighteen months thousands of badly infested sheep have been despatched. But, even amidst unfavourable surroundings, judicious management frequently suffices to ward off disease. *Mr. Frederick Street*, Somersham Park, St. Ives, tells me that although his neighbours have had repeated serious losses, his flocks hitherto have been protected from disease, mainly by keeping them off suspicious wet meadows, penning them by night on dry arable-land, supplying them throughout the whole year with concentrated dry food, and using salt.

NORTHAMPTONSHIRE has not generally suffered so much as Bucks and some neighbouring counties. A great area of the

drier pervious soils has been exempt. On low grounds, subject to floods, where ditches and drains have been unable to clear themselves, and water has stood persistently, flock-masters have suffered. Butchers at Kettering, like many of those elsewhere, aver that few cattle and sheep these two years are as ripe and full of fat as formerly. Not many flukes are found in the beasts. The ewes and older sheep are more affected than the younger. Cross-bred sheep which are becoming more general are said to be scarcely so much affected as the Leicesters and longwools. On some farms never before producing a rotten sheep the flocks have been swept away; bad-doers have suffered most; very heavy losses have been sustained by those who delayed clearing out their infected flocks. Sheep which might have realised 60*s.* have often melted away at the rate of 16*s.* to 20*s.* in a fortnight, the lean meat becoming pale, soft, and shrunk. Around Kettering and Market Harborough it is, however, gratifying to learn that in February 1881 there was less disease than twelve months previously. *Mr. John J. Sharp*, Broughton, wrote that in November and December 1879 he bought 300 suspicious sheep at very low prices, kept them as well as possible with a full allowance of dry food and access to rock-salt; they did very well indeed and paid money. Repeating the experiment in 1880, he bought another lot of risky sheep; with some difficulty managed to clear them off without loss; longer kept, they would certainly have wasted and died.

LEICESTERSHIRE has an unenviable notoriety for flooded meadows: for three months during recent years many hundred acres have been under water. With rivers and streams obstructed by dams and weirs, with broken down banks, and silted up beds, surface and drainage water is slowly removed, and much even of the lighter land dries tardily. In the neighbourhood of Leicester, on the lias and marl land, many flocks were affected in the autumn of 1879, and still more are now unsound; some have been entirely cleared out. The valleys of the Wreak and Welland have always been regarded especially liable to rot sheep in a wet time, and evidently have lost none of their unenviable character. The valley of the Soar, on more porous soil, is generally drier and healthier; but even here, as on the higher lands, and where no rot has been known for half a century, this visitation has extended. Cattle, as well as sheep, are infested. Butchers in Leicester declare that more than half the sheep reared within twenty miles have flukes, and the only sheep within reasonable distance which they can depend upon being sound are brought from the Grantham country. During February and March, 1881, the Leicester fellmongers reported that there are received every week 2000 casualty skins, mostly

stripped from rotten sheep. *Mr. Miles*, of Keyham, farms upwards of 600 acres; despite good feeding, all his flock are tainted, and have to be hurried out at what they will fetch. *Mr. Joseph Roe*, Scraptoft, was careful not to put his sheep on his flooded meadows. Nevertheless he found that in 1879 many were fluked; 55 were lost. In 1879, and still more in the subsequent year, condition and flesh so quickly disappeared, that few made 20*s.* each. *Mr. Thomas Carver*, Six Hills, Leicester, occupies 350 acres of upland well-drained land, on portions of which, however, the water frequently stands for several days. His 150 breeding ewes, although they have been living on roots, are distinctly affected.

Mr. Charles Bland, of Gaddesby, ten miles from Leicester, under date 14th February, 1881, reported that: "liver-rot is much more prevalent amongst sheep this year than it was last. The older sheep in 1879 were carried off, but more recently old and young suffer alike. Several farmers in this neighbourhood have lost the whole of their flocks. On the uplands the sheep are affected as much as on the lowlands; but on land recently seeded, the cases of rot are less numerous, and the sheep do better.

"For several years we have kept Welsh sheep on this estate, and all have been affected with liver-rot on their arrival here; we ascertained this by killing, for the use of the Hall, several a short time after purchasing them.

"We attribute the prevalence of liver-rot to the successive wet seasons, which have changed the nature of the herbage; destroying the fine kinds of grass, and encouraging the growth of other injurious kinds.

"For several years we have bought heifers two and a-half and three years old, from the county of Kerry, to kill for the use of the Hall. When we buy them, there are generally a few in better condition than the rest; these we push forward to kill as early as possible. Sometimes we have killed one within a month of its arrival here, and have always found the liver very rotten, either with flukes or ulcers—mostly the former. This has always been the case with the earlier killed—that is, those we have had only a short time. The longer we keep them the more the livers improve; the ulcers disappear, but the livers are never entirely free from flukes.

"A farmer in an adjoining parish is losing all his young calves, which were reared last summer; their livers are full of flukes, and he cannot imagine the cause of their being so affected. Calves that are housed do not suffer.

"A pig was killed at Rolleston, Leicestershire, one day this week; its liver was found to be as full of flukes and as diseased as that of any rotten sheep."

The frequently flooded tenacious lias clay and sticky marls in the neighbourhood of Loughborough present a black list of losses. *Mr. David Aitkin*, M.R.C.V.S., has informed me that the majority of the flocks in 1879–80 have been affected—many have been reduced to one half. Rot is no new thing in this locality; 100 years ago Bakewell, at Dishley, is said purposely to have rotted his ewes sold to the butchers to prevent their being disposed of for breeding purposes. The Dishley farm is now principally used for dairy stock. At Tilton-on-the-hill, six miles from the town, are 6000 acres of poor cold land untenanted; on the arable land not a plough has been at work for two years. In this district rot abounds. The Chanworth Forest land, although stony, and now fairly drained, is poor and naturally wet; the flocks at the best of times are difficult to manage satisfactorily, and during the past two years most are seriously suffering. Large portions of land in this neighbourhood have been repeatedly and extensively flooded; water has stood for months in many furrows; outfalls and drains have become choked; the land has not been safe for any sheep, nor even, as experience shows, for cattle. Although draining during fifty years has considerably limited the rot-area of ordinary seasons, butchers, veterinarians, and observant agriculturists, concur that fully half of the sheep raised in the neighbourhood of Loughborough, during the last two years, have been fluked, and the proportion of those infested continues to increase.

Mr. Warner Lacy, of Coates, keeps 400 sheep, and generally lambs 150 ewes. In 1879, amongst his sheep, chiefly kept on the lower grounds, he lost upwards of sixty, and sold many at less than 10*s.* each; this year ninety have been sacrificed. The younger sheep, kept exclusively on the higher lands, are hitherto sound. *Mr. Isaac Harrison*, Tedbury, amongst his home flock, on heavy wet land, has lost many; 160 are already gone, being double the mortality of last year; but seventy lambs, which when weaned were sent into the drier Market Harboro' district, although many of them were from rotten ewes, are perfectly well and thriving. Mr. Harrison further informed me that from the strong land of high Leicestershire 1000 fluke-infested sheep have for months been sent every week to the metropolitan market, and occasionally the supply has doubled. Many, which if sound would have netted 60*s.*, were then realising less than 20*s.* *Mr. Roberts*, of Hurst Farm, with his father-in-law, keeps 800 sheep; although on stone-brash, said to be fairly drained, without stagnant pools, with no history of any rot on record, and the flocks sedulously kept out of flooded fields, the losses, nevertheless, reached 300 in 1879, and 200 in 1880, and still the sheep are pining. It is the home-bred hoggs

that are here chiefly attacked; many apparently sound one week are far gone the next, and, in spite of good nursing and medicine, shortly die; six or eight are sometimes skinned in a day. There are numbers of rabbits on this farm, many have been found dead, presumably from flukes; it is not unlikely that they have contributed to distribute the parasites.

Mr. Tyler, of Thorpe Villa, lost 100 last year, and some hoggs this year. One tup lamb escaped for a day into a neighbour's flooded field, and three months later died full of flukes, whilst its fellows are still thriving and apparently sound. *Mr. Wright*, jun., Sandy Acre, informed me that his home-bred sheep, on tolerably dry upland, are sound, whilst sixty bought lambs, from a suspicious source, three months after purchase were dying. *Richard Benskin*, Loughborough, has had twenty-eight years' experience of butchering and farming; although he has frequently looked for them, he has never seen flukes in young or fat lambs; the worst and most rapidly fatal cases of rot, he rightly declares, are in poorly-kept sheep. Last spring, from a lot of fifty-seven useful stores he sold fifty to a farmer, not remarkable for his good keeping, in about four months they were sickening and dying; the home-bred flock, amongst which they were run, continued sound. The seven culls sold to another neighbour and well fed throve and lived. *Mr. J. Lacy*, Walton, has well-drained land, uses amongst his flock a liberal amount of concentrated dry food, and believes that newly laid-down land will, if wet, rot sheep as badly as old pastures, but considers that by thorough draining even clay soils may be rendered free from rot. He has recently been losing a few ewes, and has sold others at 52*s*. badly fluked. He is of opinion that they became affected prior to his purchasing them in the autumn of 1879. They have since reared a capital crop of lambs. *Henry Bordan*, of Normanton-on-Soar, although carefully keeping his sheep off the flooded meadows, has this year lost several, and his beasts are now affected. To liberal supplies of dry food and drenching with Professor Simonds' prescription of salt and sulphate of iron he ascribes his light losses.

Amongst these and many other sufferers are near neighbours, occupying thoroughly-drained land, who have sedulously kept their flocks off the wet meadows, who have been liberal with cake and corn, and who have hitherto kept clear of the disease. *Mr. James Hudson*, Seagrove Lodge, farming 700 acres, bought eleven infected black-faced ewes in 1879, lost all but two, has since bought another small lot, which have had to be sacrificed; but his home-bred flock as yet is sound. Samuel Singlehurst, Kingston-on-Soar, bought six black-faced ewes, fifteen months ago, which died rotten; he has been especially particular with

his home-bred flock, which he believes to be free from disease. *Mr. L. W. Stephenson*, Normanton Hill, on thoroughly drained land, keeps 400 sheep; although there has been much mortality on the farms around he has escaped liver-rot; but unfortunately, in February 1881, his sheep and beasts were suffering from foot and mouth disease.

The Vale of Belvoir, beginning at Old Dalby, near Melton Mowbray, runs fifteen miles west, is four to five miles wide, contains much rich feeding-land, but in olden times had an unenviable reputation for rotting sheep. The property chiefly belongs to the Duke of Rutland, lies mostly on the blue lias; a great deal of it is imperfectly drained; some of it is liable to flood. The farms are small; the manufacture of Stilton cheese is the chief industry. The older inhabitants informed me that losses from rot occurred in 1829 and 1830; on several farms every sheep was then cleared off. Equally evil fortune has befallen many during the present visitation. Some of the farms which formerly had an evil repute have not, however, now suffered. The Stathern farm, which used to rot sheep badly, has been thoroughly drained, and the flock still continues sound. Mr. Rowbottom's farm, of Goadly, at Marwood, was wont to rot sheep even in dry seasons. Five years ago it was thoroughly drained, and, notwithstanding the provocation of the last two years, the flock remains healthy. Whilst the disease has been general on the wet heavy clays in the valleys, the adjacent higher ironstone lands, through which the water quickly percolates, have furnished very few cases. A still more notable exemption occurs in the midst of the vale. On a gently elevated eminence at Hose, *Mr. Joseph Stevenson* has kept his 80 sheep perfectly sound, whilst his neighbours all round have been heavy losers. Another rather interesting case of immunity is the North Field Farm, held by *Mr. John Pacey*. The farm rises a little out of the level plain, and, although rather more porous than some of the adjacent land, was long notorious for rot; but since it has been thoroughly drained no cases have occurred, and it even now presents a clean bill of health. In the Vale of Belvoir the cattle for two years have done badly, and now there are frequent losses amongst them from rot. Few hares and rabbits are met with in the district, and I am unable to obtain any evidence as to their health. I am told that they were infested with flukes in 1829, and I learn that the hares this winter have run badly, which is a suspicious circumstance.

Mr. Robert Littler, M.R.C.V.S., at Long Clawson, ascribes the prevalence of rot in his own and other districts to the persistent effects of several wet seasons. The rainy year of 1860,

fortunately followed by drier seasons, did not materially increase the prevalence of rot. With the sequence of wet seasons the flukes get more numerous and widespread, whilst the sheep become more weakly and liable to suffer. Although the flocks in the Vale of Belvoir are less numerous than in the winter of 1879–80, there is now more widespread and greater loss. There are probably double the number of rotten sheep in February 1881 than there were twelve months previously. Many farmers are sufferers who last year escaped. The beasts are more generally affected than they were twelve months ago. Many of last year's cases were more acute; this winter they are more chronic, and accompanied by greater weakness and wasting. The ewes and older sheep, probably having to rough it more than the hoggs, contribute the greatest proportion of cases. Indeed, some of the old farmers until lately have not thought lambs liable to flukes. Mr. Littler has examined scores of lambs taken from ewes in the last stages of rot without finding a single fluke, any eggs, or any indication of disease in the liver. By embryotomy he has removed lambs from ewes in *articulo mortis* from rot, and known them to grow and thrive as if from the soundest dams. He discredits the idea that flukes can be conveyed to the progeny in the milk of the mother. On the grass and clover, as well as in the garden, Mr. Littler during the last two years has observed enormous numbers of the cream-coloured slug. The little hard black slugs, he states, are not so abundant, and are found on the arable more than on the grass-land. The grey slime these slugs leave on their trail, presumably sometimes contains the flukes in the cercarian form in which they enter the body of the sheep. In 1829, on three conterminous farms in Long Clawson, all the sheep died from rot. The flocks were replaced, and again swept away in 1830. Occasional losses have since occurred. One of the farms, and half of another, in the occupation of Mr. Samuel Doubleday, remain in their wet unimproved condition, and half the flock has perished from rot in 1879, and again in 1880. The third farm, and one half the second, were, however, carefully drained five years ago four feet deep; any damp or swampy places have been dried. The tenant, Dr. Doubleday, has 50 ewes and 24 hoggs, and during these two recent fatal years has only lost five sheep, none of them from rot. Such facts surely demonstrate the importance of draining as a preventive of rot.

Mr. William Cook, of Long Clawson, farms several hundred acres. Five acres on the lower part of the farm are frequently flooded, but the sheep are carefully kept out of this. The land generally is fairly drained, but neglected outfalls lower down on other people's property detract from the efficiency of the drainage. Last year Mr. Cook's losses consisted of a dozen

ewes which were sent from home for eight weeks to the ram. Since then the disease has spread, and in 1880 one hundred were attacked, have died, or been got rid of. The ewes and other sheep, which for two months were kept on the stubbles, have hitherto remained sound; those which during August, September, and part of October were on the pastures have largely failed, and probably are all unsound. Amongst them the longest survivors are a score which during one month were kept upon the stubbles. This removal from the infested grass appears to have stayed the progress of the disease for six or eight weeks. In illustration of the manner in which sheep may pick up the parasites Mr. Cook and Mr. Littler told me that Mr. Shipman, of Stathin, purchased 40 sheep at Grantham from a sound farm. Twenty of them were sent direct home, and did well; the remainder lay one night in some flooded meadows near Loughborough, and in four months were all dead. Another case coming under Mr. Cook's cognizance shows how short a sojourn on infected land sometimes suffices to produce rot. A lot of sheep bought at Grantham, and driven to Melton, in a few months all died rotten; whilst one of the lot which had been lame, and was brought home in a cart, had nothing amiss with it.

William Shipman, of Hose, is a judicious and liberal manager; his flock numbers 180; about half are ewes; in the late autumn of 1879 he lost 25; he kept the others well, and got rid of most without much sacrifice; a few held over became again attacked in October 1880, and are worthless. A lot of ewes bought in during spring he has had on dry land at Branston, and will have them home to lamb, keeping them liberally; but, in such times, unwilling to run risks, will finish them off. *Thomas Hukerby*, of Hose, usually has 80 ewes, lost none in 1879, but they began to fail during the autumn of 1880, and now forty-one are dead, and few of the others are likely to live to bring forth their lambs. The land is not subject to floods, but it is not drained, and holds the water that freely falls upon it. *John Stokes*, Hose, occupies 36 acres, with 18 acres belonging to himself, is a careful man, and a heavy stocker; part of his land is subject to floods. He lost a few home-bred sheep in 1878, replaced them in May 1879 with sheep from sound land, began to lose these in November; has besides had six yearlings in 1879, and nine since, die unmistakably from rot. His total losses reach 250*l.*

Mr. William Shipman, of Harby, has sound and unsound land, but the latter has recently been reduced in amount by draining. On his suspicious land at Hose he ran 60 ewes until September 16th, 1880, when they were sent stubbling;

one accidentally injured and killed at Christmas was perfectly sound; none of them appeared to be tainted. Forty lambs which were subsequently sent on to the same pasture are now dying rapidly, but 10 fellow-lambs which remained on the drier land at Harby are perfectly well. This case confirms the popular opinion that October is one of the most dangerous months for sheep on wet lands. Mr. Shipman is nursing his casualty survivors on barley, bran, and linseed-cake, and believes if they live until the fresh grass springs, that they will get rid of the parasites, and may pull through. *Mr. Baguley*, Harby, has a considerable portion of low-lying wet undrained pasture; even the upland is insufficiently dry; he has lost 46 ewes and 40 hoggs. The ewes kept longest on the worst land went first; some of the lambs, sent early to dry arable land in Nottinghamshire, have been saved. From a good dry situation 50 stores were bought last April; by October it was evident that they were going wrong, and they were at once wisely sold. *Thomas Lamin*, Harby, has drained his land, but not as effectually as it should be for the recent wet seasons. Flooding occasionally occurs, and the pastures as well as the arable are apt to get puddled. He generally has 50 ewes, of which seven died in 1879; but now, February 1881, most are pining and appear likely to go. Like many others, as recently as the middle of January, he would confidently have warranted his flock sound. His 30 beasts are not doing satisfactorily, and he has no doubt that every one has flukes. *Robert Bark*, Harby, during two years has lost 80 sheep, and has not heart or money with which to replace them. What is to be done next May-day with these, as with many others of the less desirable wet fluke-infested Leicestershire pastures?

John Bloore, Langer Lodge, has a tract of flat poor soil on the lias clay, part of it is being drained now for the first time; some of it seriously subject to floods, now lies covered with silt; rushes and coarse grass monopolise the pasture; the clover seeds and other portions of arable are decidedly swampy. The circumstances of this farm are as promising as can be for the development of flukes. In the summer of 1879 Bloore had 60 ewes and 30 hoggs kept much alike; in September they began to fall away; in October they were dying latterly at the rate of four or five a day. Many were fairly well one week, and dead the next; a few were nursed over the winter, but did little good; a loss of 250*l.* has been sustained on the sheep; the yearling cattle moreover are doing very badly, and although getting malt combs and linseed-cake, several will die. *Mr. Goodwin*, Langer, put 102 ewes to the ram in September; now all are dead or sold as casualties. The hoggs, which seldom in

this locality suffer so seriously, have also died or gone at a sacrifice; a score that were nursed through the winter of 1879–80 are now dying; their livers evidently having been damaged twelve months ago, a new crop of parasites, taken up this summer, is speedily finishing them. *Mr. James Stokes*, of Branston Lodge, farms 300 acres, keeps 150 sheep, fully one-third being breeding ewes, worth anywhere 60*s.* each. In 1879 he lost six or eight; now his death-roll, which dates from September, exceeds 40, and in spite of liberal careful treatment, it will get bigger. Sixteen of the best of his 87 hoggs were sent to keeping on better but wetter land; these died first. On 44 acres, more porous and naturally drier, above his house, Mr. Stokes summered 44 ewes, which have as yet withstood the disease.

South of Melton and Belvoir Vale, by Wissendine, Stableford, Pickwell, and Newbold, away towards Oakham, on the flooded pastures and tenacious soil, rot has been generally and fatally prevalent, both in 1879 and 1880. In many parishes scarcely a sheep is left; on some farms a second flock, bought in to replace that which died, has been carried off. The cattle-beasts of all ages are doing indifferently; a considerable number have died with numerous flukes in their livers; and very few killed within the last six months are free from them.

NOTTINGHAM has not suffered so severely or extensively as Leicestershire. Many of the large flocks on the red gravel and sandy land have escaped. The losses are greater towards Trent and around Worksop. Mr. J. Manners Sutton, Kelham, Newark, stated, however, that in his parish all the sheep died, or have been killed, with flukes. Around Nottingham it has spread considerably since the autumn of 1880. On the Duke of St. Albans' estate, Bestwood Park, although the land is light and tolerably dry, the losses have been serious. *Mr. Henry Potter*, of Bestwood, wrote that the disease was first seen in that locality about Christmas, 1879, amongst some ewes belonging to J. Oldham, which had been grazed in September at Bulwell on low land, regularly flooded by the River Lien. They shortly began to die, and not one escaped. They doubtless took the disease from the flooded land. On the farm adjoining, 50 Scotch lambs were on turnips, 33 were already dead, and the remainder in a sinking state. During their transit from fair to fair these Scotch sheep were probably run upon some unsound land, and brought the disease with them; for although they are all doomed, the farmer's home-bred flock remains perfectly healthy. Mr. Potter continues that, disbelieving in the infectious nature of the complaint, he is sending his own sheep to the farm where the lambs are dying,

intending that they shall remain until they lamb. The dry food which he gives to every description of stock, even during summer, he rightly considers prevents rot, and many other serious disorders, and he concludes with the observation, "the more I vary the food of my sheep, the faster they thrive."

Mr. Samuel C. Machin, Forest Farm, Pappelwick, occupies 600 acres, 70 of it old turf, all dry in ordinary seasons. He never had a rotten sheep before 1879; has a dry flock, usually of 1000. He lost 80 during the autumn and winter of 1879–80; they were feeding-sheep sent in September to graze 30 acres of eddish, through which ran two streams, on the banks of which the grass was very rampant. He remarks that 1880 has been worse than 1879. Two farmers a mile from Forest Farm, who never had a rotten sheep in their lives, have had all their in-lamb ewes infested by eating the fast-growing grass along the banks of some open drains. Mr. Machin's own sheep, he says, went quicker this year on the luxuriant eddish than they did the previous season when it was more closely grazed. He believes the mischief is most commonly done between June and September. He has had no cattle or horses affected. Not all flooded land is liable to rot. Mr. Machin mentions that he has a brother farming 500 acres in Yorkshire whose land is frequently flooded, but he has never had a rotten sheep. Flocks confined to the sandy land never have rot. He sold Mr. Hardstaff, of Linley, 40 sheep last year; his own all died of rot, but those from Forest fed with them never failed. Ewes affected twelve months ago are now being sent to the butcher. They have not done well; their livers are hard and not fit for use; probably owing to the liberal dry feeding the flukes are small and weakly. Dry food and salt, Mr. Machin insists, should be given to sheep at all times.

Mr. Henry Smith, The Grove, Cropwell Butler, farms about 1200 acres in several parishes of the two counties of Notts and Leicester. His land is about half arable, half pasture, all well drained. Two or three fields, however, in Cropwell Butler, are cold and retentive clay, on which both Mr. Smith and his shepherd believe that the ewes became affected. Rot has hitherto been unknown, but in 1879 ten ewes were unmistakeably rotten, and thirty more have since been lost. This, however, is a small proportion from a flock of nearly 1200. All are home-bred Lincolns of high reputation, producing prize-winning rams, well kept, receiving at most seasons dry food, and now having constant access to salt. Low wet lands, often flooded, Mr. Smith considers the cause of rot. He is not aware of any particular plants that appear on pastures liable to it. He has not observed any increase of slugs. Small birds abound on

his farm, sparrows and rooks at certain seasons doing considerable damage. He has a great many fowls in boxes moved on wheels about the fields, and where these fowls are mostly kept he declares that he has no fear of rot. He understands that hares and rabbits during the last few years have been found dead on the low lands with flukes in their livers. He has lost bought-yearling bullocks from rot, but has not known any cases in horses. Asked if lambs or calves reared exclusively on their mother's milk are ever affected by flukes, he replied, "Decidedly not." The disease, he stated, was very serious in Notts and Leicester in 1879, but it has been worse by far since. Many farmers have lost, and others are now losing, the whole of their flocks. Although the flukes are picked up during the late summer months, a variable time occurs before the disease shows itself. Sheep well kept, and in mild weather, may be six or eight months before they show any falling off. The sharp winter usually carries off the affected. The recent six weeks' snow and frost has given a quietus to thousands. On good dry land Mr. Smith has no fear of rot. The flooded land he finds most dangerous, and in illustration refers to the two adjacent parishes of Cropwell Butler and Tithby; in the former not a sheep is attacked; in the latter, where for two years the grass has been frequently flooded by the Smite, nearly all the flocks, both ewes and hoggs, were affected, and were sold off. When once a large colony of flukes are in the liver Mr. Smith has no confidence in any cure, but believes that salt and dry food will maintain general health and may stave off the fatal issue.

In DERBYSHIRE the sheep census of 1880 shows a diminution of about 20,000, or a reduction, as compared with 1878, of about one-tenth of the total flocks of the county. This short-coming is mainly due to liver-rot, and, judging from the losses of the present winter, still greater diminution will be noticeable next summer. On the Mansfield sandy land attacks have been limited. They reach their maximum of extent and severity on the heavier clays and on the poorer dairy farms, where sheep are a secondary consideration, and where extraneous feeding is seldom used. The white-skinned sheep are sometimes stated to suffer most, but locality has much more to do with the prevalence of the disease than the breed. *Mr. Richard Hall*, Thulston, occupies a cold upland farm, and keeps 600 to 1000 sheep; he lost during 1879 about 25, and during 1880 double that number, these, however, have all been purchased sheep; no sickness has yet appeared amongst the home-bred flock. The breeding ewes in August were sent from home to run over 400 acres of stubble. Many of the cattle, alike home-bred and bought, are thriftless, doubtless infested by flukes; several

beasts killed have had the liver indurated, enlarged, sometimes grown to the sides, and always containing flukes. *Mr. Radford*, of Thulston, on a flat table-land, has lost 100 sheep during the last two years. *Charles Finney*, Smerrles, Elwell, holds a strong clay farm, but none of his land is subject to flooding. He has had losses to the extent of 300*l.* amongst both bought and home-bred sheep, and 25 per cent. of his flock have already died or been sacrificed. He milks 33 cows; they have produced during the last two years just one-third less milk than they were wont to do in more favourable seasons; one cow has died lately full of flukes. The young and feeding cattle have made slower progress than usual, and unless carefully managed there will be serious losses amongst them before the winter is passed. *Mr. Edwin Canner*, Stanley Grange, has 50 breeding ewes and about the same number of hoggs; he had never seen a case of rot on his farm previous to December 1879, but has since had too much experience of it. Without effect, he has tried many remedies, and has lost, or sold at a low figure, upwards of 100 sheep. *Charles Eaton*, Attwall, between Michaelmas 1879 and Ladyday 1880, lost 200 home-bred sheep; bought in 80 more, most of which have gone at from 3*s.* 6*d.* to 4*s.* each; 14 yearling cattle have also been lost during each of the last two winters. This farm consists chiefly of strong marl on a blue clay, and washed gravel subsoil; some of the lower fields are subject to flooding, previous to 1879 cases of rot were, however, unknown.

Mr. Arthur Tomlinson, Stenson, although his land is light on a gravel subsoil, has of late years had his fields standing for days under water which could not get away. He has carefully fed his flock liberally, but in September suspected his ewes, and had two killed; he found flukes, and without much loss, for they were still in good condition, got rid of 120; six, kept as an experiment, sank rapidly, and were soon worthless. *Mr. Beeby*, Kingston, had 300 sheep, and lost each year about a score, whilst the others have done badly, partly from flukes and partly from their being run too thickly owing to the necessity of shunning the flooded land. *Mr. Gilbert Murray*, of Elvaston, besides furnishing me with information himself, obligingly gave me introductions to various Derbyshire flock-masters. He told me that a lot of Dorset ewes brought into Derby market about Michaelmas 1879 were divided; one half continued perfectly sound, the other in two months showed disease, and many died shortly. This shows an unusually rapid progress of the disease. At Elvaston, although the land is not dry, 150 Shropshire ewes have done well during the two last winters, but they have had trough-food twice a day and constant access to rock salt. The silt

on the frequently flooded meadows is believed to damage cattle more than sheep, and causes inflamed bowels and diseased livers, especially in young cattle and those in poor condition.

Butchers in Derby concur in the statement that although twelve months ago the cattle were comparatively sound, their livers are now quite as much diseased as those of the sheep. Cattle evidently stand up better against the complaint; even when the liver is invaded with flukes and much consolidated and hardened they do not waste as quickly as sheep do under similar circumstances. Almost every Midland counties beast now slaughtered is said to be affected. One extensive butcher, who kills upwards of 50 cattle a-week, stated (Feb. 11th) that he had scarcely seen 20 lbs. of sound ox liver since Christmas. The only bullocks free from flukes, at present killed in Derby, come, he said, from Yorkshire or Norfolk. Sound sheep are still brought from many parts of Lincolnshire, from Cumberland, and other northern English counties, and from Scotland.

Mr. Aylton, M.R.C.V.S., Derby, has noted the extension of rot during the last two years on many farms previously healthy. Usually by purchased stock it has been spread over fairly dry uplands. It has appeared on many farms between Derby and Ashbourne, where there are no flooded lands; it has left not a sheep in the parish of Murchiston; even the mountain sheep on the Peak have been affected. All parasitic diseases, he remarks, have recently been on the increase; hoose amongst young cattle and sheep has been especially common. Many cattle have been attacked by flukes; many deaths have occurred, especially amongst yearlings. Animals whose livers have previously been injured by the continued residence of many flukes, if a second time attacked, very certainly and speedily perish. Within the last few months he has seen two horses die from liver flukes, one, a six-year-old, grazed last summer on a flooded meadow. Judging from their coats and poverty, many colts are this winter infested, and deaths are now occurring amongst those left out starving in the unsheltered fields. Derbyshire farmers, he continued, are not yet sufficiently alive to the importance of protecting their live-stock from inclemency of weather and furnishing them with adequate supplies of nutritive food. Early and judicious treatment, Mr. Aylton stated, should save three-fourths of any properly kept stock attacked by flukes. The losses, he believes, largely depend upon poverty, and upon trouble and expense being grudged in the ordinary management, and in the earlier stages of the attack.

WARWICKSHIRE farmers have experienced large losses amongst flocks on flooded lands along the banks of the Tame in the north, and the Avon and Alne in the south, as well as on the

poor elevated land about Birmingham, on the coal measures and magnesian limestone between the Midland metropolis and Nuneaton, and on the tenacious lias which occupies the south-eastern third of the county. *Mr. John Bennett*, Theddingworth, Rugby, before 1879 scarcely knew what flukes were; his land is fairly drained, and he has 1000 home-bred sheep. Notwithstanding the judicious use of dry food, he lost in 1879 and the early part of 1880 upwards of 300 ewes and theaves; they died in lamb and after lambing. Throughout the autumn and winter and until February 1881 the breeding flock created no apprehension, and looked well; but before the end of the month they were failing, slipping lambs, and many will again be lost. The flukes appear to have been picked up from second year's seeds and meadows on which, in these recent exceptional seasons, water stands even in summer for several days.

Mr. Osborn Hills, M.R.C.V.S., has given the following detailed account of the prevalence of rot in the Leamington district in 1879–80:—

"Few counties have suffered more than Warwickshire, although I am happy to say the worst is over, and, for the last month or so, it seems to be gradually subsiding, appearing to have had its fatal course without any check from artificial services from the hand of science.

"The part of the county earliest attacked which came under my notice professionally was Leamington Hastings, whence the Rev. Mr. Sitwell forwarded affected livers to me for examination. I believe he lost a great many, in fact, I have heard from a good source, nearly all. Just round that district, Granborough, Napton, Stockton, and Southam suffered severely. Coming nearer the centre of the county I found on inquiry that Mr. Reading, of Snowfall, has lost over 300, and he has not a sheep left on the farm.

"Hunningham was also affected. I lent Franklin a tup lamb to put to a few ewes. The tup was there about a fortnight. When he returned I put him back again with my own lambs, and in two months my man drew my attention to him, and I could then detect the early symptoms of the disease. I had him placed in the rickyard with another lamb, and endeavoured to get him meaty, supplying the best of food, with a little sulphate of iron and salt sprinkled over his provender, but all to no purpose; he gradually got worse, and I sold him as a screw. He was my only loss out of my little flock of 50.

"John Mursott, of Weston Hall, lost between 200 and 300 two and three-year-old sheep, but not one of last year's lambs. All had, however, been treated the same and kept on the same pasture. The only explanation I could give of this was that the older

sheep ate more, and therefore had more chance of contracting the disease.

"On the other side of Leamington, John Garner had a severe outbreak which caused him to lose and to part with one of the finest flocks of sheep in Warwickshire. Mr. Pattison, the man who bought Captain Nichol's land at Ashborne, has every one of his affected. Coming on towards Warwick, John Robbins, of the Asps, had one or two cases, but quickly transferred them to other hands. Chadshunt, Gaydon, Kineton, and all round Stratford-on-Avon have had it severely.

"In a circuit of about seven to ten miles round Leamington nearly all parts have thus been attacked. As far as my own experience goes, Stoneleigh and Kennilworth have been the most free from its ravages.

"I have had only one case where cattle have been distinctly affected, and that was a calf about six months old, the property of Knight of Milverton."

On the heavier lias clays between Kineton and Shipston-on-Stour heavy losses have been sustained on farms subject to flood. Second year's seeds, on which the flocks fed last autumn, are reported to have been the source from which the parasite was frequently picked up. As in other districts during the past eighteen months, more than half the sheep have been unsound, their livers abounding with flukes; some are now met with having solidified indurated livers, the ducts being hard and almost cartilaginous. There are evidences of irritation and inflammation induced by flukes, which were numerous twelve months ago; but which, having attained maturity, have since been got rid of. From these cold clay imperfectly drained districts hundreds of rotten sheep, anæmic and dropsical, have frequently been sent to Warwick and Stratford markets in waggons. The shaking of a six or eight miles journey has sufficed to finish many of them, while the wasted enfeebled survivors have not brought more than the value of their skins. *Mr. J. B. Lowe*, Ettington, farms 750 acres, three-fifths of it arable; a few acres are liable to flood. The land is heavy, on a clay subsoil; 600 to 700 sheep are kept; the ewes live on the grassland; the lambs, for at least nine months after birth, have dry chaff with corn or cake, and sometimes a little salt. Rot has been practically unknown on the farm since 1830, but in the autumn of 1879 several cases occurred, and now nearly 400 have been attacked. The ewes suffered most, and many which, by good feeding, managed in 1880 to bring up their lambs are manifestly unsound. Even the lambs, since weaning supplied with dry food, kept mainly on second year's seeds and then transferred to turnips, are also infested. Two years have sufficed

to spread the parasite over thousands of acres to which it has for half a century been a stranger.

South of Stratford, along the Avon banks, many flocks were decimated early in 1880. Even on well-managed farms previously sound, and where dry food is freely used, such as that of *Mr. John Adkins*, Milcote, numbers of sheep have been infested. Mr. Adkins lost about one-fifth of his home-bred ewes, apparently contaminated by occasional grazing on the flooded meadows. Good feeding and penning on the arable land at night seemed to ward off mischief during 1879, and it was only in June 1880 that disease appeared.

Lower down the Avon, at Broad Marston, *Mr. C. Corbett* has been an extensive sufferer. Without experience of the complaint in former years, during 1879 and 1880 he lost about 500 sheep. Ewes were worst affected, but neither lambs nor any sort of sheep escaped; they have shown symptoms usually in September or October, indicating that the parasite had been picked up by Midsummer or soon after. Sound ewes bought August 5th began dying in December. Mr. Corbett considers that he has scarcely a pasture-field that for two years could be trusted to carry sheep. Even some of the clover leys are not now safe. There are no stagnant pools, but the land is constantly surcharged with water. Better outfalls through which the heavy rains can be carried off and thorough draining he regards as the only remedies. He has had many cows, bullocks, and younger cattle affected, and a calf of nine weeks old, house-fed and receiving nothing but its mother's milk and a little flour, when slaughtered, disclosed several flukes in its liver. Both hares and rabbits have died rotten in great numbers.

Worcestershire reveals much the same story as Warwickshire. On the Severn and other valleys, and on all the heavier wetter lands serious widespread losses have occurred. Most of the farmers who congregate at Evesham market have had sad experience of attacks during the autumn and winter of the last two years. If there is rather less loss during the past than the previous year it mainly results from the reduced number of sheep. Ewes clearing up the bullock pastures, often run more thickly than the tegs, seldom receive dry food so early in autumn, and having besides their strength tried by gestation and nursing, contribute the largest number of cases. Interesting instances requiring personal investigation and corroboration occur of portions of a flock run for a few days over flooded meadows and becoming rotten and dying within three months. Cases are mentioned of part of the ewe flock kept for six weeks or two months on the stubbles, and remaining sound, while the residue left on the old pastures are all dead. Numerous instances have

occurred of cattle of all ages becoming thriftless and even dying from flukes in the liver, gathered from the supersaturated or frequently flooded pastures.

The Marquis of Hertford's deer in Ragley Park during 1880 were infested with flukes, probably derived from sheep turned in during the previous year to clear up the rough herbage. Twenty bucks shot early in the season, *Lord Yarmouth* informs me, were seriously infested. When dry food and salt had been given for several weeks the bucks then killed exhibited a healthier condition of liver and fewer flukes. Like other good managers *Mr. Charles Randell*, of Chadbury, keeping his sheep pretty constantly in pens and on well-drained arable land, and supplying them constantly with dry food and salt, has not suffered from liver-rot. *Mr. Edward Wheeler*, Ryewood House, Tenbury, by similar treatment, out of 380 Shropshire ewes has lost only six, although many of his neighbours have had to make serious sacrifices.

STAFFORDSHIRE.—Rot these two years has ruined many Staffordshire farmers. Over the large area of flooded land and the colder retentive clays, which abound in this county, the mortality has been most serious. *Mr. J. Woodroof-Hill*, M.R.C.V.S., of Wolverhampton, on February 23rd, thus reported:—"There has been more rot in the sheep of this district during the last twelve months than has been known for many years. In my capacity as veterinary adviser to the Corporation I have inspected considerable quantities of mutton from 'fluked sheep,' pronounced it unfit for human food, and had it destroyed. Indeed, for some months untainted and first-class mutton has been at a premium. No cases of fluke in cattle have come under my inspection, nor yet in hares or rabbits, but my assistant, *Mr. J. T. Phillips*, M.R.C.V.S., tells me that hundreds of the latter died in his part of South Wales during the winter of 1879–80 from fluke. Many instances have come under my observation in which the disease has been confined to portions of a flock. My opinion as to the extension of the disease over lands formerly exempt is that it is due to want of drainage on those lands and the continued wet, and consequent multiplication of slugs. No cases in unweaned animals have yet come under my notice. As Professor of Veterinary Medicine and Surgery to the Wilts and Hants Agricultural College, I may mention that their flock of 1157, reflecting much credit on the management of Professor Wrightson and his assistant, Mr. Hutton, has been peculiarly exempt from fluke, only one case having come to my knowledge. The fact of the College lands being chalk, capped with gravel, and the sheep pastures being on very high ground, may account for this immunity."

CHESHIRE.—*Mr. John Roberts*, Well House, Chester, has been twenty-four years in his present holding, and until the present visitation never knew a sheep rotten, excepting when he sent some ewes from home in November and discovered them to be fluked in the following February. On 700 acres, one-third of it old pasture, the remaining arable, flat and some of it liable to flood, 210 ewes and about 300 young sheep are kept. Using for all the sheep tolerably regularly throughout the year half-a-pound each of decorticated cotton-cake and bran, and keeping them mostly on the arable land, Mr. Roberts has escaped with small loss; he does not use salt. But throughout the county many farmers have lost or had to sacrifice their whole flocks. Numerous cases occurred last year and the year before of sound Welsh ewes brought upon Cheshire farms in November and dying in March. The lambs from these ewes seldom have anything amiss during their first summer; they probably pick up the parasite late in the autumn, and die in February and March. Ewes badly fed and pulled down by bearing or nursing two strong lambs first show the disease. On the thin-skinned clay flats which hold water, even on some of them when fairly drained, the losses have been dreadful; where there is stiff clay soil and subsoil, even the hanging land has caused much fatality; where there is a porous subsoil the mortality has not been so serious; on the gravel soils the flocks and herds are stated to have been hitherto sound. But Mr. Roberts and others affirm that the disease is greatly more widespread than it was twelve months ago. No particular grasses are observed on land liable to rot, nor many slugs or snails, which are noticed rather in gleaming weather on rich good land which is not subject to rot. Many feeding beasts have suffered; even these have been depreciated to the extent of a penny per pound. Many young cattle, chiefly eleven and twelve months calves, were dying from rot. One neighbour of Mr. Roberts, who cannot keep sheep, has lost twenty calves. No cases of flukes have been met with amongst unweaned young calves or lambs, or amongst horses. On one of the principal estates in Cheshire the keeper during the last few weeks has picked up eighty hares with enlarged livers full of flukes. This presages a still widening distribution of myriads of ova.

Anglesey, Carnarvon, and other parts of North Wales, have produced a good deal of rot on wet, retentive, and frequently flooded soils. *Mr. R. B. Smith*, Penrhyn, Bangor, ascribes the immunity of Lord Penrhyn's and other carefully managed flocks to keeping them off wet lands, ditching and draining the wetter mountains, providing good hay for winter use, salting the hay when ricked, and having rock-salt always within reach of the sheep. Adopting these precautions he has not had a case of

fluke for fifteen years. Mr. Smith remarked "that many of the Welsh mountains before they were drained were subject to rot, but since drained they are quite free from it. The free use of common salt in hay, and rock-salt in the field, has a deterrent effect in our case at least. Some of our neighbours who use no salt suffer from this disease, although their land is comparatively dry. The want of dry food in winter causes much loss to our mountain farmers, especially in wet seasons, such as 1879, when much of the runs are overflowed and marshy, the pasturage coarse and unhealthy, and little or no hay can be made for the flocks. The only cure I have ever seen is to get the sheep fat, and kill them as quickly as you can. Up to a certain point they fatten easily."

HEREFORDSHIRE.—*Mr. J. H. Arkwright*, of Hampton Court, Leominster, instituted extensive inquiries throughout Herefordshire regarding the prevalence of rot during 1879, and the first half of 1880. With zealous labour he communicated with upwards of eighty stock-masters. He found that the disease was widespread amongst both sheep and cattle; that it has extended over farms which from time immemorial have been exempt from flukes: several of the valuable pedigree-flocks have been sufferers, and fatal cases have also occurred amongst several of the fashionably descended Hereford herds.

Responding to Mr. Arkwright's inquiries, *Messrs. Edwards and Weaver*, the auctioneers, reported that their Hereford Market sales-books indicate that they first sold what were supposed to be rotten or fluke-livered sheep about the last week in August 1879; since that time sheep have constantly been disposed of at prices ranging from 7*s.* 6*d.* to 27*s.*, which should have realised, had they been sound, from 50*s.* to 63*s.* per head. Amongst others who have been great losers may be mentioned *Mr. Charles Nott*, Bury House, Wigmore, who lost or sold as diseased all his ewe stock from the Bury House Farm. *Mr. Helme*, of Devereux, Wootton (late of the Broome), lost in the autumn of 1879 several sheep purchased of Mr. Thos. Nott, who, we are informed, lost in 1880 the greater portion of his older sheep. Mr. Helme had sheep indicating rottenness, but attributes his saving his flock to a very liberal use of salt with a very little nitre. He has lost none since his removal to Devereux, on the Garnstone estate. *Mr. Henry Moore*, of Fields Place, on the Garnstone estate, has lost or had to sell as diseased, the whole of his ewes on the Field Place Farm, but they have remained sound on Chadnor Farm, adjoining. *Mr. Thomas Rogers*, The Homme (a farm adjoining Mr. Moore's), has kept his flock sound. *Mr. Bull*, of the Bear Farm, Weobley, out of 92 ewes, sold 12 at skin price, has 20

left, the rest died of fluke, some as lately as April, and instead of having over 100 lambs he has thirteen. *Mr. Thomas Cranston*, Ryon House, from his Newton Farm, Dilwyn, has lost the greater part of his ewe stock. *Mr. Geo. Ritt*, Chadnor, lost heavily of his Shropshire ewe stock. *Mr. Geo. Bray*, Henwood, Dilwyn, had heavy losses amongst his older sheep. *Mr. Jas. Smith*, Bedney, lost nearly, if not all, his white-faced flock. A small farmer (*Bowen*, of Dunwood) had 26 ewes last autumn, he has now six, but they are worthless. *Mr. Finney*, Luston, has been a great loser. Immediately round the town losses have been very heavy, but a great many of the cases have occurred in sheep purchased. *Mr. John Ludge*, Ivington Court, has ten such sheep left out of 125 bought in Hereford Market of Mrs. Evans, Swanstone. *Mr. Griffiths*, Hyatt, Larnsfield, has lost a great number of his older sheep. *Mr. Pierce* and *Mr. Vaughan*, of Norton Canon, have lost nearly all their older sheep, and a great number of the younger. *Mr. Griffiths*, Little Larnsfield, has lost heavily. *Major Worswick*, Larnsfield, has also been a great loser.

Mr. Arkwright has furnished very full reports of the admirable management followed on his home-farms. One extends to 958 acres, 800 acres being old pasture, the remainder arable. The land is drained and sound. The flock numbers 470 Southdowns and Leicesters, invariably kept on the old grass from December to April, fed besides on hay, cotton-cake, oats, and salt, which is used freely at all seasons. Rot has been unknown until 1880, when sixteen cases occurred. The Shropshire Downs suffered more than the Leicesters; the two and three-year-olds more than the lambs. No explanation can be given of the introduction of the disease; the running stream, river, and pools are not considered injurious to the sheep: no particular plants or weeds are observable in the meadows. The disease is believed to be contracted between June and November; few are noticed to be amiss before November. Frost and severe weather generally lead up to the first symptoms. Snails and slugs are numerous on the arable land, but not on the pastures. Starlings, during the past two years, have been reduced in numbers, but no difference is observable as to the numbers of other birds. Dry food and salt are believed to be the most effectual remedies for preventing rot and arresting it in the early stages.

Mr. Arkwright's Stone and other home-farms at Pencombe comprise 765 acres, in about equal proportions of old pasture and arable. The land has been drained, and is fairly dry; the pasture is hilly and generally well adapted for sheep, of which 445 are kept chiefly upon the arable land, their diet usually being supplemented by concentrated food. Twenty-four ewes died

in 1879; sixteen in 1880; the yearlings and lambs hitherto have escaped. There are no boggy places, open ditches, or stagnant pools, such as occur on many adjacent farms where the flocks have been nearly destroyed by liver-rot. During recent rainy seasons, the coarse blue carnation-grass has increased, and is considered injurious to sheep. Liver-rot is stated to be most generally contracted in May or June; its symptoms are apparent in October and November; and the highest death-rate is in March and April. No increase of snails has been observed. Birds are as numerous as usual, excepting starlings, which in the winter months congregate much upon the pastures, and of course must find some food there.

Mr. Arkwright's keeper, in answer to questions furnished, reported that the deer-park contains 177 acres, lies high and dry, is bounded by a running brook, has no open ditches or stagnant pools. It is stocked by 160 deer, amongst which fifty cases of rot appeared in 1879, and twenty in the first half of 1880. No such disease was observed before 1879. From November to April the deer are fed with hay and beans, occasionally with acorns and chestnuts, and since the autumn of 1879 they have also, with benefit, had rock-salt placed in boxes about the park. The yearlings and fawns chiefly suffer. The fifty fawns of 1878 died in the spring of 1879, and twenty of those of 1879 also died when about twelve months old. They began to fail about November, as soon as the cold weather set in. The keeper reported finding many dead hares and rabbits with enlarged spotted livers, and distended stomachs and intestines, but containing no flukes. He concludes that it is desirable to leave a quantity of old grass over the winter; without it the young spring shoot is apt to cause relaxed bowels and lowered condition. Deer attacked by liver-rot are said never to recover.

The central portions of Herefordshire comprise many serious sufferers from liver-rot. *Mr. James Smith*, Leominster, lost one-third of his flock in 1879 and nearly all the remainder, with some fresh purchases, in the winter and spring of 1880. *Thomas Green*, Kinnersley, from liver-rot has lost all his sheep and many of his cattle, and in consequence has had to give up farming.

Mr. Richard Farr, Much Dewchurch, farms 344 acres in equal proportions of tillage and pasture. More than half of the land was last year very wet and boggy, and grew carnation-grass. No losses occurred from fluke until 1879; since then, upwards of forty ewes have died; twelve ewe lambs run, after weaning, on recently laid down seeds, also perished when about eleven months old; the wether lambs receiving corn have all recovered; two yearling cattle, wasting to shadows, died

fluked; and other nine are distinctly, but not as badly, affected. Drenches of various kinds, costing in all 20*l.*, have been tried without much success; some of the ewes drenched cast their lambs. Dry food and rock-salt have also been used, doubtless with benefit. But to all rules there are exceptions, and Mr. Farr mentions that one of his neighbours had forty lambs, which from weaning-time ran in the grass fields, and never had a handful of dry food; two died in winter completely rotten, but all the others survive.

Mr. G. Roycroft, The Roda, Kington, the successful breeder of so many prize Herefords, although his land is cold, naturally wet, and not particularly adapted for his Shropshire Downs, has hitherto managed to keep them sound by the early liberal use of dry food and rock-salt, which he rightly considers beneficial for all animals.

Mr. Thomas Edwards, Howton Farm, Wormbridge, Hereford, in reply to a series of questions forwarded the following detailed information:—"I usually keep about 230 sheep. At the beginning of 1879 I had 90 breeding ewes and 140 yearling sheep; all were more or less affected with liver-rot; 120 died; some made 2*l.*, others from 15*s.* down to 7*s.* 6*d.* each. I had 17 calves, which ran out all last summer with their dams, two of which showed symptoms of liver-rot; one died, the other is a mere skeleton, the remainder are affected, but I do not think to the extent of endangering their lives, or very much impeding their growth. Although I have been at Howton since Candlemas 1872, and always kept a good flock of Shropshire Down Sheep, I never had a single case of liver-rot till last year.

"Having a small proportion of tillage as compared with pasture, I am forced to graze my sheep chiefly on the pastures all the year round, the young sheep being sometimes penned on a field of roots, but more frequently the roots are carted on to the clover-leys or pastures.

"In the summer the store sheep are not supplied with artificial food, but the draft ewes and yearling wethers intended for the butcher usually have a pint of Indian corn daily, and are sold to the butcher in the months of July or August.

"My farm is about 232 acres; 90 acres is tillage, the remaining 142 acres meadow and pasture; there are no woods. The soil is a low-lying sandy loam, tending to a clay, with a clay subsoil, mostly artificially drained or naturally dry. The proportion of wet land, as near as I can judge, is 30 acres, portions of which are scattered throughout the farm.

"The whole both of my ewes and yearlings were affected. The lambs became affected in June or July; several then

slaughtered for the house had flukes in their livers. The lambs began to show outward symptoms of disease as early as the middle of September, and a good many died; the remaining 70 I sold for 30*l.* I believe the disease shows itself sooner in lambs than in older sheep.

"I am certain that the whole of my flock suffered from liver-rot; why some showed it more than others I cannot explain, unless it be that their constitutions varied; I invariably found the weakest first showed symptoms. The only reason I can give why some flocks were affected and those adjacent not, is that on farms where the sheep have escaped liver-rot they were in small numbers proportionately to the quantity of land, and were thus kept chiefly, if not wholly, on the tillage-land, which had been previously thoroughly drained. As an instance, a neighbour of mine, Mr. Cooke, having 50 cows, kept a small proportion of sheep, has not had a single sheep affected, whilst all my other neighbours have lost all theirs, or suffered to a considerable extent. The lands in my opinion that produce rot are either undrained, or, what is worse, insufficiently drained. There are plenty of wet and boggy places in the pastures about this neighbourhood. These lands were fairly adapted for sheep till within the last year, since then these wet places have grown little or no natural grasses, but a quantity of blue carnation-grass, bulrushes, &c. There are also plenty of open ditches and stagnant pools, intended for catching water for summer pasturing.

"Cattle have suffered as well as sheep. My neighbour, Mr. Jones, lost 14 cattle from rot, and myself two. About one-third of the liver of a fat cow slaughtered on the next farm was useless. A yearling heifer which died from quarter evil was affected with liver-fluke, but not to such an extent as would account for death. On some of my own I tried a good many remedies, but my experimental cases nearly all died. I do not think it possible to cure an animal of liver-rot when the disease has a good hold on the system. I lost a yearling colt about a fortnight ago; in his liver I found flukes, but not to an extent that would account for death. I therefore conclude that all animals which graze are more or less liable to liver-flukes, which I have found not only in cattle, sheep, and horses, but also in pigs, hares, and rabbits. I do not think that cattle show symptoms of disease nearly as soon as sheep. When manifested, I do not think there is any material difference in the progress or symptoms in cattle or sheep. When grass is allowed to get long, it is not as likely to produce rot as when it is closely grazed. As an instance I may mention that a neighbour had a quantity of sheep last summer

which did well where the grass was long, whilst mine on short grass closely grazed got rot.

"The disease is contracted at different times in different seasons. In 1879 I think that lots of sheep and lambs got it as early as May or June; but the most likely months in my opinion are September or October.

The disease manifests itself much sooner in some cases than in others. Sheep that are well cared-for, having cake and corn and roots, do not show symptoms as soon as those that are left to pick up their own living. The time that elapses from taking up the flukes and the production of the first symptoms is two to three months, but in some cases more.

"I have noticed no difference in the kind or numbers of snails or birds in this locality. As to recoveries, I have only a ram remaining from my old rotten flock, but whether he is now sound I cannot tell. I believe dry food and regular supplies of salt prevent liver-rot. I have tried other remedies on cattle and sheep, but once the disease gets a good hold on the system I do not think there is any cure for it."

In East Herefordshire *Mr. Arkwright's* reports attest that to Midsummer 1880 *Mr. G. Hall*, of Garford, lost 70 sheep; *Mr. Homes*, Gold Hill, 160; *Major Brown*, Hall Court, 150; *Mr. G. Louth* was also a great loser; *Mr. Marston*, Newton, had to sacrifice all his flock; *Messrs. Davis*, at Eggleton and Fairtree, between them had 300 sheep badly rotten, but their neighbour, *Mrs. Pudge*, on similar ground worse done, lost none; her immunity she believes depended upon her flock running thinner, and in the abundance of pasture, not grazing low enough to pick up the embryo flukes. On the Stoke Edith estate the land is fairly dry, and the losses have been light, at the date of June 1880, being estimated by the Agent, Mr. Henry Parker, at 100 sheep, a few cattle, but no horses.

North Herefordshire has been extensively devastated. *Mr. T. Nott*, Bucton Park, in fifteen months had losses amounting to 1500*l.*, including many of his show sheep; but his namesake at the Furlongs, although surrounded with rotten flocks, lost none. *Mr. Matthews*, although occupying a very wet farm—the Willows, Ludlow—escaped, his flock were repeatedly drenched with salt water. *Mr. J. Green*, Marlow Lodge, Leintwardine, has been a great loser. He mentions that *Martin*, of White House, and a neighbour between them bought a quantity of diseased sheep; *Martin* asserts that he cured his with Professor Simonds' recipe, the whole of the other lot died.

In West Herefordshire *Messrs. Yeomans*, *Goodwin*, *Jones*, and *Williams*, have experienced great losses. Several contiguous occupiers, especially those at Dorstone, have escaped. *Mrs.*

Turner, Eardisly Park, R.S.O., lost 12 sheep, which, contrary to orders, had been turned on a wet pasture. None of the others suffered. *Major Warswick*, of Sarnesfield Court, Weobley, wrote June 2nd, 1880:—"Although I have been a sufferer by the fluke, my evidence will hardly be valuable, as I do not know from what fields my sheep got it. My land was half of it drained, and they roamed over the whole both years. However, I kept my lamb hoggs after they were weaned on clover-aftermath, and on cabbages and turnips, and preserved them. Their dams all went off with rot last autumn. As regards the dry food so much talked of, no one uses more than I do, but I have not given it to ewes after the lambs are taken from them, and it was at that time, namely, from July to September, that the ewes doubtless contracted the complaint. I do not know anyone anywhere who gives cake and corn to ewes after the lambs are taken from them. Around here are numerous cases of cattle whose livers, when slaughtered, are found to be full of flukes, and my bailiff declares that he recently saw in the house of one of my tenants the liver of a fat pig containing many flukes."

In the hill country towards Radnor, for forty years unscathed by rot, heavy losses have been sustained, especially where the land is cold and poor, and the sheep during late autumn and winter have been hardly done. One occupier in Radnor Forest is said to have lost 1000 sheep, and many smaller men in Old Radnor parish count their losses by the hundred. Grazing in summer and autumn on flat clay-land, from which the water does not readily get away, is the usually ascribed cause. The failing flesh, the pale watery eye, and other symptoms, have generally shown themselves in December after cold or wet weather. Some victims are said to die six weeks after they are seen amiss, but others are kept alive much longer, especially if put upon dry food.

In South Herefordshire, around Ross, a good many flocks have been decimated. *Mr. D. Buck*, Glewstone, lost 50 ewes, which for only a few days had the run of a wet meadow. *Major J. M. Bennett*, Markhall, had to sacrifice all his valuable flock of Shropshire ewes. *Sir E. Cockburn*, in the light sandy Ryland country, wrote, 30th May, 1880:—"My opinion is that half the losses from rot have occurred from want of proper nourishment, and from the gross ignorance of many farmers and shepherds. In the summer of 1879, for instance, when the mischief undoubtedly began, there was abundance of grass. Many fancied that all was right; but observant shepherds know well that a short pasture is preferable to a luxuriant one, especially when the luxuriance consists of wet washy grass. During

August I observed my sheep, which were running rather thick, uneasy, and eating any earth they could get at. My shepherd and myself considered that they suffered from acidity; rock-salt was immediately invested in, and artificial food given. The almost total failure of the turnip-crop in 1879 also told in this locality against sheep; both ewes and tegs were accordingly kept much later than usual on the pastures. I hold that no sheep need die of rot even on a rotten farm, if helped with a little dry food. Half the rot of last year was caused by poverty. On my dry sound land I keep 700 sheep, and have hitherto lost none."

MONMOUTHSHIRE.—*Mr. R. Stratton*, The Duffryn, Newport, Mon., in May 1880, writing to the Secretary, described the mortality and loss in his district as having been very great among sheep and young cattle, and stated that he had heard of a few cases of horses dying from the disease. "It would be difficult to name a farmer who has not suffered more or less. I have lost considerably in sheep, and have cattle more or less affected. Any number of farmers would be happy to give their experience on the subject, but I think no satisfactory inquiry can be held simply by letter. Some one or two of the Committee should make inquiry on the spot, when I would get some of the leading victims to give evidence. One of the peculiarities of this outbreak is that it has occurred on lands which have hitherto been considered safe, and it is most difficult to determine *where* the disease was contracted. I believe mine was done on second clover, which was *full* of grey snails when we were feeding it. Another peculiarity is that, although the sheep have been together all the season, some are perfectly rotten, while others are perfectly sound. The proportion of sound and diseased varies in a remarkable manner: in one case 5 per cent. only are rotten, in another 75 per cent."

GLAMORGANSHIRE.—*Colonel F. Picton Turbervill*, of Ewenny Priory, Bridgend, in the summer of 1880 sent circulars to many farmers throughout the county of Glamorgan inquiring the extent of their losses from liver-rot amongst sheep and cattle. Thirty farmers responded. Their aggregate losses of sheep approached 2800: their losses of cattle were 110. Where the flocks were replaced the disasters during the subsequent autumn and winter have nearly doubled; many more cattle have been lost. From the six divisional Veterinary Inspectors reports were also obtained. The infected area includes the whole of the southern parts of the county bordering on the Bristol Channel, extending from Cardiff to Ogmore River, comprising the elevated plateau reaching from the coast, and varying from fifteen to thirty miles inland to the mountains, where, especially in the

mineral districts of Merthyr Tydvil, Aberdare, and Pontypridd, the disease has not, however, been so widespread.

Mr. George Hopkins, The Hayes, Cardiff, reports:—"I have killed on an average 30 English sheep weekly for more than twelve months, and have not had five livers a week fit for sale: some of the livers were so enlarged as to weigh 8 pounds. I attribute the disease to excessive wet weather, and the animal endeavouring to nourish itself with watery grass. I bought in January of this year 50 ewes heavy in lamb, looking healthy and fat. They lambed in February, were fed on roots, hay, and crushed oats. In spite of this they fell off day by day, and in March commenced dying, and now at the end of May I have five left. The lambs from all these fattened fairly well, and have now been killed off, viz., 62 in number; but every one of the said lambs were touched in the livers; the older they got, the worse the livers were. My opinion is that a rotten-livered sheep gradually gets worse, and if suspected, should be killed at once to save further loss. I have tried dry food, green food, rock-salt, once a week in troughs; but there is no cure. I have also sold American carcasses of mutton weekly for twelve months, and, judging from their general appearance, and in particular the fat on the kidneys, I have never seen anything approaching a rotten sheep; therefore I would suggest the restrictions now imposed on American live sheep should be removed, in order that we might import them alive and breed from them next September. If some such plan is not adopted I firmly believe in two years we shall scarcely have a sound sheep in the United Kingdom." *Jenkin Jones*, Highlight, Cardiff, believes that the heavy summer rainfall leads to rot. His land is not very favourable for sheep; he has been in the habit of changing them every year, and until November, 1879, escaped losses. The hardy mountain sheep purchased annually from the same source were bought as usual in September; in little more than six weeks they began to fail; many were soon dying; 62 were totally lost, 71 realized 10*s*. each.

Mr. Charles Moir, M.R.C.V.S., Cardiff, remarks that there is scarcely an owner of sheep in the district who has not suffered greatly. He added, in the neighbourhood of Llancarfan, I am told the disease has attacked sheep in the marshes where it was never known before, and in Rumney district nearly every sheep has gone. *Mr. Tinker*, Cornenwell, Penarth, has had the disease amongst his young cattle, which died perfectly anæmic—in two examined the livers were hard and full of flukes. The survivors, treated with iron tonics and liberal diet, under this treatment improved. They lived in sheds all the winter, and were fed on hay and cake without roots.

The flukes had probably been picked up during the previous autumn. Mr. Moir had been told that many young cattle have died between Newport and Chepstow."

In answer to inquiries regarding the recent prevalence of the complaint, Mr. Moir obligingly sent me the following information (February 19, 1881):—"In Glamorganshire, at least in this district, the disease, although it has prevailed to some extent this winter, has not been so destructive as it was twelve months ago. I do not know that its type has altered. I have not heard that any cattle or horses have become affected, at least to such an extent as to cause death, but the butchers tell me that many of the cattle killed now show signs of previous disease and in a few the liver is rotten.

"It has long been my opinion that hares and rabbits carry the disease on to fresh ground—hares more especially, as they travel over a greater amount of ground than rabbits do. During the last winter a great number of dead hares were picked up having all the symptoms of rot. This is one way of accounting for virgin land, if I may use the term, becoming affected. A good many sheep died of rot on the salt marshes 12 or 14 miles from here. Such a thing was never known before. Last winter there were very few farmers who did not lose less or more of their sheep from rot. Some indeed lost all; those that did not actually die were sold for what they would fetch. Flock-masters who were most fortunate kept their sheep as dry as they possibly could, shifting them from one place to another, frequently on to seeds; they also allowed them hay, oats, malt-dust or cake. A good many sheep apparently affected were thus saved or the disease arrested, giving time to secure a market for them. By my advice the chaffed hay was mixed with the oats, cake, or malt-dust, very often with pulped roots, and watered with a solution of common salt in the proportion of one ounce to the gallon of water, increasing the strength as the sheep got used to the taste. The water was put into a common watering-can with a rose to it and then poured over the mixed food. A good many cattle in this district also died from rot last winter. The best treatment I found for them was removal to fresh pasture as dry as possible, or, if possible, to house them; give a liberal diet and twice a day a powder consisting of gentian, nitrate of potash, and carraways, all powdered, of each two drachms mixed in the feed; with this treatment a great many recovered. I have been told, but do not know for a fact, that a good many colts died of rot last winter. I have not had an opportunity of making a post-mortem, neither was I fortunate enough to get a liver to examine. There is a widespread belief that carnation-grass is a cause of rot in sheep, and this belief is

materially fostered by the great quantity of the grass seen in wet seasons, and as a matter of course when rot is prevalent. This, however, is easily explained. The grass grows fast in wet weather and is more readily seen. Dry weather is generally fatal to it, or, if it grows at all, it does so very slowly. Farmers then, seeing so much of the grass during the prevalence of rot, come to the conclusion that it is the cause of the disease."

On the low meadows in the Cowbridge district, on the retentive lias shale, draining is not sufficiently attended to; stagnant ditches, pools, and springy furrows are very common, and for two years rot has abounded. Colonel Picton Turbervill's correspondents have furnished the following information. *William Loughler*, Llanvethin, used hay when the weather and grass became indifferent in the wet autumn of 1879, found his sheep do fairly, but when worse weather came at Christmas they died rapidly, to the number of 50 ewes and 60 lambs. Eleven cattle have also followed with the same symptoms; but they are, he says, more easily doctored and saved than the sheep.

Mr. Edward Thomas, Laneadle, four years ago lost 60 breeding ewes from rot. His land is not dry; several boggy places occur in the pasture-fields; he believes that in a wet season it grows noxious herbs which cause rot. In the winter of 1879–80 he lost 44 ewes, although he says that he gave them rock-salt during the greater part of the summer and autumn, and hay and oats regularly twice a day from October. *Edward Jenkins*, Plumark Place, considers his land generally suitable for sheep, with the exception of two small fields which the flock are not allowed to enter. Although with no previous experience of rot 270 sheep have been lost in 1879 and 1880. *D. Spencer*, near Cowbridge, lost 100 ewes during February and March, 1879. Neighbours who saved theirs have not been great gainers, for the survivors are reported to be weak and thriftless, consuming much concentrated food, but making no progress. *D. H. Davies*, Eglwsbrewis, has a wet farm, on which 100 sheep died rotten in 1860, and 40 perished in 1879. The wet boggy portion of a field, he believes, did the mischief this time. Dry food and salt might, he thinks, have been serviceable if adopted in time. *John Lewes*, Brigham, is satisfied that grazing sheep on wet meadows produces rot. His yearling sheep, restricted to seeds on dry land, are sound; 120 breeding ewes and two-year-old sheep run during the autumn and winter on the meadows are all dead from flukes. Thorough draining, Mr. Lewis believes, is the only remedy for his case.

Mr. A. B. Price, Westhouse, Bridgend, considers this visitation to be more subtile than any previously occurring. In November, 1879, he examined carefully all his sheep; believed

that they were sound; white frosts set in, which, he remarks, are always against the stock; by December 1st several were dead; 48 perished outright; 80 were sold at 5*s.* each. *Mr. W. Thome*, M.R.C.V.S., Bridgend, has examined many sheep that have died during the trying winter of 1879–80; many have had flukes and have died from the irritation and inflammation engendered by them, and similar results he has observed in young cattle. The statement that the horses at Waterton Court suffered from flukes requires, he thinks, confirmation. Many cattle and even sheep which have lately perished, have died, he states, from poverty, with enlarged dropsical livers, but have been free from flukes.

Mr. William Davies, Pilton, Swansea, has occupied his farm for forty-eight years. Until fifteen years ago he never knew what rot was; faulty drains and wet seasons have rotted a few most years, but in 1879 and 1880 the whole flock was swept away. *Messrs. Holland Brothers*, Gower, in November 1879, happening to kill a ewe, found her liver full of flukes, and, submitting to a small loss, sold out all the breeding flock. Soon the yearling cattle became thriftless, and five died; their livers were enlarged and hardened, and contained many flukes of unusual size. *Mr. Thomas Small*, M.R.C.V.S., Swansea, remarked that after several wet seasons on all wet lands rot is liable to prevail, and its occurrence under such circumstances is greatly encouraged by the poor indifferently nourished state of the stock.

Mr. D. Nicholas, Veterinary Surgeon, Aberdare, reported that up to the end of May 1880 he had encountered no liver-rot either in sheep or cattle in his private practice, or in the performance of his duties as Inspector under the Contagious Diseases (Animals) Act. Within the last nine months cases both in sheep and cattle have, however, been common.

In GLOUCESTERSHIRE for two years the disease has extended, attacking sheep on land formerly regarded as perfectly sound. During the winter and spring of 1880 thousands of sheep were cleared off; many both alive and dead were sent to the Metropolitan markets. The Agricultural Returns indicate that in Gloucestershire in June 1880 there was a falling off of upwards of 60,000 sheep as compared with 1878 and 1879. Cattle as well as sheep have been attacked. *Colonel Kingscote* bore testimony to the almost ubiquitous distribution of flukes, and furnished lists of sufferers. *Mr. Edward Bowly*, of Siddington, and many of his neighbours have been losers. Replying to a series of questions, *Mr. James Peter*, Ham Villa, wrote: "The Vale of Berkeley is a dairy and cattle, not a sheep, district. Much of the land lies under the level of the Severn, which,

especially at spring-tides, blocks the outfalls twice in 24 hours, and causes great difficulties in the draining of wide areas. Grazed on such lands sheep would soon be rotten and dead. The few lambs successfully wintered on drier pastures previous to 1879 cannot now be risked. The unhealthy water grasses which have taken hold of the soaked land have much to do with rot. Where they have not had a good supply of dry food a great many cattle have suffered. We use a lot of salt, which I think is a capital thing and a great preventive for liver-rot. I have known several calves a few weeks old killed for veal with large flukes in the liver. These, I think, must have been born in them, as they have never had anything but milk. We used to have plenty of hares and rabbits in this part of the country, but few have survived the flukes. I do not think that ducks or geese prevent liver-rot, for on a part of this property by the Severn, on land which has always been subject to the disease, thousands of wild geese stop all winter and feed over the meadows. Much fairly dry ground, which used to afford capital grazing for sheep, and was suitable enough for rearing lambs, has caused rot during the two last seasons. I do not think that any cure will be found until the face of our pastures is altered by two or three dry seasons."

On the heavier level lands about Swindon, off which water drains very slowly, the ravages of rot have been very disastrous, and several farmers have been entirely ruined.

WILTSHIRE.—*Lord Suffolk and Berkshire*, whose estates lie in North Wiltshire, near Malmesbury, has paid considerable attention to the disease. In his neighbourhood, hitherto perfectly free from such visitations, he considers that the losses in 1879 were greater than in 1880. Cattle have not been frequently infected. Contaminated sheep kept on pastures and clover have, he believes, spread the disease broadcast. With the summer tropical rains to which we are now subject, few places, he states, are so high and dry as not to be wet enough occasionally for fluke breeding. On a farm recently taken in hand, consisting of cold clay soil, and chiefly undrained, the whole flock, numbering 130 ewes, were attacked in the early autumn of 1879; 100 bought sheep fortunately sold off early in the year escaped. On the home farm, on a pervious limestone rock, 150 ewes and 200 lambs and fatting sheep remained sound, although grazing the whole year on old pastures and having dry food only in the lambing season and salt occasionally. These Southdowns, however, added his Lordship, were not so well done as the flock which perished. During the summer of 1879, Lord Suffolk remarked that the home-farm lambs were on the wettest part of the Park where, if anywhere, they might have been expected to

rot. But, to secure their thriving and prevent scouring, every morning between five and six they were penned and had hay, Indian meal, bran, and a little cake. This liberal treatment was probably the cause of their immunity from liver-rot.

Messrs. Fry, Oldfield, Marshfield, Chippenham, responding to my list of printed questions, stated that they hold 458 acres, of which 247 are arable; 164 acres of pasture is springy land, with open watercourses, and portions at times flooded; 300 ewes and their lambs constitute the flock, which is kept from December to the end of April on roots, with hay and corn, then moved to trifolium, rye-grass and vetches, and at times run on the old grass. Scarcely any flukes ever occurred until the fatal year of 1879. Towards the close of it 279 home-bred ewes were affected; 23 actually died, but the lambs then escaped; 132 of them, however, were attacked when about twenty months old, but were speedily got rid of with only two deaths. The lambs each year have escaped, owing, Messrs. Fry sensibly suggest, to their being taken from the grass early in the autumn, and folded on roots, with hay and a portion of dry trough food. On the pastures much carnation-grass has grown during recent years. Close grazing of suspicious land in the later months of the year is stated to conduce to the disease. Messrs. Fry have not seen flukes in the livers of their cattle. The fat beasts have died sound, but many of the younger animals have been lean and starved, as if they had flukes. Messrs. Fry further remark that open ditches, stagnant pools, spouts or boggy places, are incidental to all the farms in the neighbourhood, and that all have been, and were then (February 22, 1881), affected with liver-rot. Although the owners might not care to admit it, Messrs. Fry state that in their parish of 10,000 acres there is only one sound flock.

In the Northern English Counties liver-rot has been more scattered and occasional. *Mr. R. W. F. Mills* has recorded that a good deal of disease occurred on low wet lands liable to flooding, in the neighbourhood of York. It has also appeared on several farms near Rotherham. Its attacks have extended to wet land, whether clay, gravel, or sand, and are spread over most geological formations. The disease has generally been confined to sheep, but butchers state that since 1879 flukes have been increasingly frequent in the livers of cattle. On Mr. Norcliff's estate, Langton, near Malton, Mr. Houlden lost a colt. He was sent to Lord Middleton's kennels, was there examined by a veterinary surgeon, and the liver found to be full of flukes. *Mr. George H. Sanday*, Wensley, Bedale, reported that although in his district of Yorkshire there is still a great deal of wet undrained land, only a few isolated cases of rot have occurred.

Mr. Matthew Ridley wrote (May 21, 1880), "that the disease is practically unknown in Northumberland;" but *Mr. Thomas Bell*, Secretary of the Newcastle Farmers' Club, later in the summer, recorded "that fluke disease has carried off a heavy percentage of sheep in the wet district lying between North and South Tyne, west of Newcastle, on the borders of Cumberland." It is, however, reassuring that although on surrounding farms 50 per cent. of the flocks have been destroyed, one holding which formerly had the worst reputation for rot has been nearly exempt, owing to its having been recently dried with open drains. *Mr. Ralph Craig*, North Lytham, Belford, stated that although the rainfall of 1879 and 1880 has been fully an average in his district, no general outbreak of liver-rot has occurred. As usual a few cases have been met with among some of the Mountain Cheviot flocks, attributed to their eating the rapidly grown, succulent herbage around "well-heads" and springs. Ewes have it most frequently, owing to their getting, in most cases, no food except the natural herbage. More careful attention to diet, if it does not prevent, would, Mr. Craig believes, mitigate the severity of liver-rot. *Mr. S. P. Foster*, Killhow, Carlisle, has heard of no flukes in his locality. The Penrith district is reported as perfectly sound, and all live stock particularly healthy.

SCOTLAND.—At the great stock sales throughout Scotland, both during 1879 and 1880, sheep, as usual, have generally been "warranted sound," and the warrant has seldom been questioned. In April 1880, when in most English counties south of Trent not one-fourth of the sheep slaughtered were perfectly sound, visiting the Edinburgh abattoirs I was unable to find a fluked liver, and was assured by the inspectors that "they were very rare indeed." Butchers in the various provincial towns of England, as well as in London, tell me that their Scotch consignments have continued free from flukes. Thousands of ewes and wethers brought from all parts of Scotland, and distributed in unusual numbers throughout the Midland and Southern counties to fill up the ruinous gaps there made by rot, have been perfectly sound. With opportunity of getting the parasite, however, they are as liable as English sheep to take the disease; and on wet fluke-infested meadows in Leicestershire and elsewhere, within three months many have suffered. This immunity which Scotland generally has enjoyed has depended upon her summer rainfall of the last three years having been less excessive than that of England, and on her more limited area of flooded meadow and of old pasture. Some of the Western islands, receiving the copious drip from the Atlantic-born clouds, are seldom free from rot, and for two years have had more than usual.

Mr. D. Colin Cameron, Tallisker, Skye, has a summer flock of about 8500, a winter stock of 6500. Ewes and wedders are kept separate. The younger sheep are wintered partly on grass and partly on roots. The wedders are sold fat at three years old. Ewes are most frequent sufferers, and are attacked if grazed on land subject to floods. The symptoms usually show themselves in February, March, and April. Very few recover, and those that do so partially are almost certain to be cut off in the subsequent winter. Mr. Cameron in a wet year has lost as many as 150. In 1879 he lost 45, but not quite so many in 1880. As to prevention, he considers salt useful; has seen the cutting of a few open drains banish rot from a farm; gives orders to his herds to shift the sheep every afternoon from the low to the upper grazings, and endeavours daily to secure them a change of pasture.

Ireland has suffered from flukes for three years. In the Southern and Western counties considerable losses occurred in 1878, a year before they happened in England. They continued in many localities during 1879, but have ceased in great part during the drier, more favourable season of 1880. Mainly to the devastations of rot may be ascribed the reduction, as compared with 1878–79, of nearly half a million, or about one-eighth of the total sheep stock of Ireland. Along the river-valleys, where summer floods were frequent, numerous farmers suffered heavily. In counties Cork and Waterford I met many who had rotted all their flocks, and dared not purchase fresh sheep, which might share the same fate. The poor condition of many Irish flocks, their being neglected during winter, and their indifferent provision of dry food, render them specially liable to succumb to attacks of rot. The small farmers are seldom sufficiently on the alert to sell off their failing flocks whilst still they might realize a little money. Thousands of carcasses were marketed in such a wretchedly impoverished state that they were condemned as unfit for human food; and *Dr. Charles A. Cameron*, the courteous Inspector of Dublin, adds that many coming under his observation were scarcely worth transport to the Zoological Gardens or the kennels.

Conclusion.—These doleful reports of disaster and loss amply attest the widespread prevalence of fluke disease, especially throughout the Midland, Western, and Southern counties of England. Since the cold dripping summer of 1879 upwards of 5,000,000 sheep have perished or been sacrificed at small figures, representing a loss which cannot be estimated at less than 10,000,000*l*. Cattle resist better the impoverishing effects of the parasite, but some hundreds of neglected beasts have actually died; and, infested with flukes, many thriftless thousands have

been stinted out of twelve months' growth, and wasted much good food. Hares and rabbits in Gloucestershire, Leicestershire, and other counties, have been decimated. In many parks the deer have also suffered.

The general conditions which have induced and spread this serious visitation of liver-rot are generally recognised, and set forth in the preceding report. They consist in excessive unseasonable floods, in tropical summer rain, the flooding of stream and river, the supersaturation of level flats inadequately drained, or from which the surplus water is only slowly removed. There is moreover good evidence that even on fairly drained meadows and clover leys, especially where the land is tenacious, the surface soil has been so run together by reiterated rain that water has stood in quantity, and for a period sufficient to provide fitting habitat for the hatching and subsequent development of the various forms of fluke-life, and for the favourable existence of the slugs which nourish and preserve the fluke throughout one important stage of its being. The few flukes found in sheep in wet situations, even during dry seasons, and which preserve the race, have thus had ample opportunity for multiplication and dispersion. On the drier uplands, hitherto perfectly free from liver-rot, fluke ova and more advanced forms have been carried by the droppings of infected sheep, of hares and rabbits, and probably also by the feet of dogs, men, and other animals.

The inception of the parasite is usually unsuspected. For weeks or even months the presence of the mischievous intruder is not recognised. Unfortunately no symptoms, no altered pulse or temperature, no abdominal pains, no examination of the discharges, or other physical signs, indicate their existence or their doings. It is only when the parasites, reaching full maturity, produce irritation, inflammation, and solidification of the liver, and thus impair its important blood-purifying functions, that the so-called symptoms of rot are apparent. The caruncle of the eye then becomes pale and watery; the muscular tissues soft and shrunken; the wool, like other textures, imperfectly nourished, is dry and broken; from the impoverished blood the fluid parts percolate through the thin pallid vessels, giving rise to œdematous swellings under the jaw, and in other dependent parts. But before these mortal symptoms show themselves it is very important that the flock-master should know whether his sheep have flukes. The only certain mode of discovery is to kill a sheep and carefully note the condition of the liver. On suspicious farms and in wet seasons it is desirable from time to time to adopt this rude test. The presence of flukes will at once suggest that the whole of the sheep which have been in similar circumstances should be liberally fed and early transferred

to the butcher. In such cases delays are particularly dangerous, and the first loss is generally the least. There are numerous sad reflections of sheep worth 60*s*. to 70*s*. held on in hope of recovery, and rapidly sinking, until in five or six weeks they become worth little more than the price of the skin.

Sheep naturally grazing closely are particularly liable to pick up the fluke embryo in its dangerous encysted form. They take it in with the food rather than with the drink. They bite closely into the roots of the moist grass where either the infested slug or its living exuviæ are lodged. The large mass of warm food always in the first stomach of ruminants doubtless protects the intruder from the solvent effects of the gastric fluids and favours its further development. There is no difference in the liability of different breeds of sheep to liver-rot, but young, weakly, or worn-out subjects sooner suffer from the impoverishing effects of the parasites. Ewes clearing up behind other sheep, often indifferently nourished in autumn and winter, and pulled down maturing or nursing a pair of lambs, furnish a large percentage of fatal cases. Cattle, although certainly less liable to the disease, and not punished so severely by it, with the extended multiplication and distribution of the parasite have very generally taken up numbers sufficient to produce serious disorganisation of the liver. In many counties observant graziers and feeders assert that the pest has taken a year off the growth of their young beasts, added more than one penny per pound to the cost of laying on beef, and not unfrequently knocked one penny per pound off the value of the carcass. Although several cases of flukes in horses are recorded, they are fortunately rare.

Farmers naturally desire a remedy which will kill the flukes and cure the sheep. This is perfectly feasible when the cercariæ are first taken up, and whilst they are still lodged in the stomach. Salt and water, turpentine, small doses of carbolic acid, or other anthelmintics will then destroy them. When a week or ten days later they are carried to the liver and deposited there, remedial treatment becomes much less certain, and the certainty diminishes as the flukes, attaining maturity, escape into the bile-ducts. Particularly hopeless becomes all treatment when numerous parasites have produced extensive derangement and disease of the liver, and when impoverished blood and weakness are steadily pulling down the patient. Where the disease has been early detected, the most hopeful results are obtained from the use of full doses of turpentine. Sheep should have an ounce dissolved in three ounces of milk repeated daily for four or five days, and after two or three days' remission again persisted with. Such treatment is not, however, desirable

for in-lamb ewes, for it increases the tendency to abortion, which is very notable in all cases of rot. A drachm of sulphate of iron given daily with bran, oats, or bruised cake is also serviceable in combating the deterioration of blood which occurs in all serious cases. With the iron and dry food about half-an-ounce of common salt may also be mixed, or rock salt, in boxes, placed within the animals' reach. Like many other good things, salt is, however, liable to abuse. Too freely mixed with the food it frequently increases thirst, adds to the congestion of the liver, and hastens death. Where there is thirst or diarrhœa it must be abandoned or used in very carefully regulated small doses. The tincture of *Agaricus muscarius*, a poisonous fungus, is used as a fluke-specific in Poland and Russia. *Mr. H. H. Coventry*, Linford Cottage, Headly, Petersfield, writes that "when on the continent infection is about, sheep are given a teaspoonful of the remedy weekly as a preventive; patients showing symptoms have a dose three days consecutively; when the pale, watery eyes testify to an advanced stage the dose is repeated seven days consecutively." So far as I am aware no experiments have been made in England with this fungus. In various parts of the country specifics are used. Success, when attending their use, generally depends upon their being wisely employed in conjunction with concentrated dry food. Veterinarians and flock-masters concur in the primary importance of nutritive dry food in maintaining vigorous health, reducing the liability to rot, and also checking its progress. Dry lodgings greatly aid the success of remedial and dietetic treatment. Cattle affected with flukes are more hopeful patients than sheep, and fairly well managed furnish a much larger percentage of recoveries.

Credit has sometimes been unjustifiably given to various medicines on account of the discharges of flukes and of eggs which follow their administration. The mature flukes after six to nine months' residence in the liver are usually got rid of. They have fulfilled their mission and produced their myriads of eggs. Like bots in the horse's stomach, they are naturally discharged. The fresh spring grass purges them out freely, but they are also removed at other periods of the year. If the liver has not been seriously disorganised, the patient again improves. Many livers may be seen in the slaughter-houses consolidated, with the ducts hard and cartilaginous, and affording indubitable evidence of the mischief done by the departed flukes. Such sheep again picking up a fresh generation of the parasite stand a poor chance.

Although the remedial treatment of liver-rot in sheep is uncertain and unsatisfactory, judicious preventive measures produce more hopeful results. Foremost amongst preventives

is the removal from the land of the superfluous wet, requisite for the existence and distribution of the rapidly multiplying flukes and their intermediary molluscan hosts. Towards this desirable end draining and ditching in many districts are being prosecuted with unusual energy. Burst-up drains, weeping spots, even when occupying an area limited to a few square yards, afford breeding-ground for the flukes, and should be promptly remedied. Ditches should be scoured and outfalls kept in order. The removal of obstructions in streams and rivers providing quicker outflow of surplus water in many districts would greatly limit the area of liver-rot. A dry summer, such as that of 1868 or 1870, would prove a most wholesome remedy. Until wet land has been dried, either by thorough draining or by the natural operation of one or two scorching summers, it is evidently most risky to turn sheep upon it at any season of the year, even for short periods. Wet portions of fields and springy spots until properly dried should be hurdled off. Ditches should be scoured, and pools and watering-places cleaned out, for near stagnant water and in mud slugs and cercariæ find congenial lodgment.

Whilst a few morsels of grass abundantly infested with flukes sometimes suffice to contaminate a flock, the protective effect of penning sheep on dry land, especially at night, is supported by the evidence of many good authorities. The preceeding pages afford numerous examples of flocks and portions of flocks, which, although ranging suspicious pastures by day, have been confined to the stubbles, or to pens on the arable by night, and hence escaped injury, whilst their fellows kept more constantly and by night on the lower lands have suffered seriously. Sheep make an early start for breakfast, and probably at early dawn the slugs are more apt to be picked up, and leave more abundantly on the damp dewy pastures their slimy trail contaminated by the cercariæ.

Concentrated dry food, given systematically, limits in a very striking manner the disastrous effects of flukes. It maintains a vigorous state of health, enabling the sheep, even if infested with the parasites, to bear up against their exhausting effects. Flocks regularly receiving trough food, or even hay, have often escaped or suffered lightly, whilst on adjacent farms, similarly circumstanced, sheep receiving no dry food have been lost in large numbers. Lambs getting a little cake or corn have often been saved, whilst the older sheep, unfortified by such sound nourishment, have pined and died.

The regular use of common salt is well entitled to rank as a preventive of rot. Rock-salt should be placed within reach of all horses, cattle, and sheep. It helps to maintain both gastric

and general health. Licked instinctively as it is by sheep, it probably destroys cercariæ during their few days' lodgment in the stomachs, and may even somewhat retard their development if they should reach the liver.

Preventive measures hitherto, however, are provokingly powerless to grapple with the myriads of fluke ova and more advanced fluke-forms which wet seasons and millions of infested animals have so widely distributed. The wonderfully prolific parasite in its various forms is tolerably tenacious of life: in one stage it is distributed in water, in another it is protected amongst the herbage, and again in still another phase it is preserved in the bodies of slugs—which numerous observers declare, amidst favouring moisture, and in the absence of starlings and other bird enemies, have been multiplying. With the enormous distribution of fluke ova, greatly increased numbers of these molluscs must be dangerously infested, especially on all wet land. In the prevention of rot it is hence important to institute a crusade against them, and adopt the several methods advised for their capture and destruction by Professor Rolleston and Mr. A. P. Thomas (p. 28). No very practicable means can be generally adopted to destroy the infested slugs and their living exuviæ by top-dressing the pastures. Their destruction would be secured if salt and lime could be brought into immediate contact with them, but this cannot be ensured over any considerable area by top-dressings. It is impracticable artificially to convert wet suspicious meadows into salt marshes. Confined to the natural salt marshes, even during these recent rot-producing years, sheep have certainly continued sound. Salt water is fatal to the earlier forms of fluke life. On a small scale the fact may be usefully applied. Salt and lime dressings, repeated two or three times at intervals of a week, may be distributed on limited isolated, wet, springy or green spots —the suspected breeding-places of the flukes, and homes of the infested slugs. When the parasites and their molluscan hosts are more widespread, as, unfortunately, they now are over thousands of moist meadows, obviously the only certain prevention of rot is to keep the flocks out of such meadows, and confine them on perfectly dry pastures and on arable land on which tainted sheep have not ranged.

In conclusion, I have to thank the various gentlemen who, with much courtesy and trouble, have furnished me with information for the preceding report.

XV.—*Pigs; and Experience in their Breeding and Management.* By JAMES HOWARD, M.P.

THE breeding, rearing, and management of pigs is a subject which has been very ably treated by practical men who have preceded me; the question, however, is of such importance that any additional information which experience has suggested will not be without its value; further, if in the present paper I go over some of the ground which has been already well trodden, the repetition may not prove altogether unprofitable.

Like other problems connected with agriculture, that of how to rear and feed pigs profitably has been rendered not a little difficult of solution by the formidable competition which has set in from the United States and other countries.

The flesh of the pig is the principal animal food in tens of thousands of families throughout the United Kingdom; it also enters largely into the diet of all classes. Bacon is a considerable article of commerce; every grocer's shop is a mart for the article, and a noticeable feature in respect of pork in other forms is the modern growth of pork-butchers' shops. With a commendable attention to cleanliness, it is not surprising that these establishments flourish, nor that the labouring population resort to them for their supplies. As is quite natural, all classes prefer, when they can exercise a choice, home-fed and home-cured meat.

That the consumption of pork has been greatly on the increase will appear from the following figures, extracted from the Board of Trade Statistical Tables:—

Average Annual Consumption of the principal Imported and Excisable Articles, per Head, for the Total Population of the United Kingdom.

	1840.	1850.	1860.	1870.	1875.	1879.
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Bacon and Hams ..	0·1	1·41	1·27	1·98	8·26	14·84

Out of nineteen articles of food and drink included in these Tables, amongst which are tobacco, wines, malt, and spirits, only two show a larger increase than swine's flesh, viz. eggs and potatoes.

A very rapid increase in the importation of bacon and hams took place in 1872 and following years, whilst the home stock of Pigs diminished by a million head between 1872 and 1879.

From the following Table will be seen the astounding increase in our imports of swine's flesh:—

	1840.		1879.		
	Weight.	Value.	Weight.	Value.	
	Cwts.	£	Cwts.	£	
Bacon and Hams	6,180	14,657	4,917,631	8,880,223	Bacon and Hams.
Pork (*Salt*, 1840)	29,532	58,818	414,209	691,362	Pork (*Fresh*, 1879).
Lard	92	Value not published	840,819	1,420,881	Lard.
Total value ..	..	£73,475	..	£10,992,466	

The import of live pigs has not increased in anything approaching the same proportion as that of other animals. In 1860 the numbers were 24,479, and in 1880 they reached 51,030, whilst in 1872 only 16,100 were imported, and 20,037 in 1877. The highest number reached was in 1865, when the numbers were 133,280.

In the supply of animal food for the nation one element of no little importance is, that owing to the fecundity and the early maturity of the pig the supply can be far more rapidly increased than is the case with any other description of animal food. A further economical view of the matter is that in no other animal is there so small an amount of waste, every particle in some way or other being utilised, and several portions which in other animals are treated as offal are used as articles of food.

Some twenty years ago I was induced to turn my attention to the breeding of pigs through an accidental circumstance. The editor of an agricultural newspaper—a famous critic in his day—paid a visit to the Bedfordshire Agricultural Show; in his report of the Meeting, the cattle, sheep, and horses bred in the county were extolled, but it was remarked that the Bedfordshire farmers were evidently far behind many other counties in pigs. Upon reading this report I at once determined to wipe away the reproach from my native county; accordingly I commenced by purchasing two sows and a boar from the far-famed herd of Mr. Wainman, of Carrhead, Yorkshire—from which, and a young boar I subsequently selected from a first-prize pen of the late Mr. Duckering, my present herd is chiefly descended.

During the past forty or fifty years it may be said that the various breeds of pigs throughout the United Kingdom have undergone a complete transformation. Originating, accordin

to general belief, in a tamed variety of the wild hog, the pig has arrived, by a variety of influences, at the condition in which he is now seen in our showyards and homesteads. The most potential of these influences has unquestionably been the introduction of the Chinese and Neapolitan varieties; by the crossing of these with the native breeds, and by subsequent careful selections, continuous improvement has taken place.

Thirty or forty years ago the variety of breeds was greater than at present. It is a remarkable fact that whilst the different breeds of cattle and sheep, particularly the latter, have been constantly on the increase, the breeds of pigs have been diminishing in number. Climate and soil have had much to do with the increase in the breeds of sheep, but as these are not an element of importance in the case of pigs, to the influence of agricultural shows must be attributed the weeding-out of the unfittest and the survival of the fittest. Exhibitions gave an opportunity for observing the improvement made in the several varieties, and the lessons thus taught were widely felt.

For a farmer to change his breed of sheep or cattle is a step requiring the gravest consideration, but to change the breed of pigs is neither costly nor difficult; hence numerous customers have been found for the surplus stock of the successful pig-breeder, who probably has profited by agricultural shows as largely as successful exhibitors of more valuable stock.

The reduction in the number of breeds was further encouraged by the fact that Agricultural Societies either offered prizes for recognised breeds only, or gave larger sums for distinct or pure races. The result has been that at the present time only five or six varieties are recognised as distinct breeds.

With regard to black pigs, there are the Berkshire and the Suffolk or Essex. In white pigs there are the Small, Middle, and Large breeds, the two latter being most commonly designated Yorkshire Whites; a few of the old sandy-coloured Tamworth breed still remain in the north-midland counties. The breeds which have gained ground fastest of late years are unquestionably the Berkshire and the Larger White breeds; indeed these varieties, from their more rapid growth being the most profitable, have to a large extent and over a very wide area of the kingdom supplanted local and other breeds.

Large-bred pigs are more suited for farmers who prepare them for market, whilst for gentlemen or amateurs the small breeds are sometimes better adapted, especially when the object is to obtain small joints for the table, and where neatness and appearance are of more importance than profit.

As an instance of rapid growth and early maturity, I may mention that when Mr. Bowick had the management of my

farms, he was fond of sending to market what are locally termed "porkers": as much as seven guineas each was frequently realised for pigs of the Large White breed at six to seven months old, and as they were sold to the butcher by public auction at the cattle-market, these were not fancy prices. I recently said to my present manager that I thought a recurrence to the practice would pay better than selling the whole of our young pigs, as we do now, for stock purposes. I am satisfied that without a large foreign connection the breeding of pigs for stock purposes does not pay, especially in these times of depression when home buyers grudge an extra guinea or two for a well-bred animal.

Upon the general characteristics of the two principal breeds, viz. the Berkshire and the Large White (Yorkshire), I would observe, first, with regard to the Berkshires, this has been the favourite breed in the dairy districts of Berks, Oxfordshire, Buckinghamshire, and Wilts, and the breed is widely scattered in other counties; although Berkshires do not grow so rapidly or fatten so quickly as the Large White breed, they possess a strong constitution, and the quality of the hams and bacon is estimated as first class. Until recently it was held that Berkshires had a larger proportion of lean to the fat than any other breed; but some of the largest bacon-curers in Wiltshire, Ireland, and the Continent, have assured me that this notion is exploded—that the flesh of the modern Berkshire (not the original) contains too large a proportion of fat for bacon, and that some of the Larger White breeds yield a much larger proportion of streaky lean flesh. The desire to obtain earlier maturity by crossing the original long-snouted Berkshires with other short-snouted breeds, possessing greater aptitude to fatten, has probably brought about the change alluded to.

With time given, Berkshires attain to great weight; when carefully bred they possess hardy constitutions, and are prolific breeders. The average weight they attain at 12 months old is 12 to 14 scores, or say 300 lbs. In addition to perfect form, a pure Berkshire should have a coat of thick, long, silky hair, four white feet, some white on the forehead and face; a white tip to the tail, and a little white on the ears is esteemed.

With regard to the Large White pigs, I would observe that these must not be confounded with the coarse mammoth specimens of the genus *Sus*, formerly seen in our showyards and now found upon some farms in the North of England; I refer to the moderately large sort. This variety has the following recommendations: they possess hardy strong constitutions, are good breeders and mothers; the hogs grow fast, and attain great weight at an early age. I have bred many which at 10 months old have weighed over 15 score. At the Smithfield Show I have realised, from

the butcher, 10 guineas each for pens of pigs under 9 months old, and 14 guineas each under 14 months old. In addition to their being very fast-growing pigs, they have plenty of lean meat, have thick bellies—a point of great importance to the bacon-curer—and well-developed hams.

During the past twenty years I have bred some thousands of pigs, have tried the Large, Middle, and Small Whites, as well as the Berkshire—I still keep a herd of the latter at a separate homestead. I have tried crosses with Berkshires, using a Large White boar, and have crossed the different varieties of the white races. The result of my experience is that none grow so rapidly or realize so much money in a given time as pure pigs of the Large White breed.

Of all the animals of the farm, perhaps none have been so much neglected as the pig; on thousands of farms, otherwise well managed, it has been deemed sufficient to provide pigs with the poorest and most wretched shelter—indeed, in many cases, no shelter at all. To expect that even a pig should thrive in a sty placed in the worst available position—sometimes with no ventilation—and much too small, and with no regard to aspect or change between summer and winter, is to look for what Nature refuses to supply.

Then as to food: pigs are too generally regarded as simply the scavengers of the farmyard, left to fare ill or well as circumstances may determine. It is true that improved treatment has been widely adopted, but erroneous notions still largely prevail that pig-rearing and feeding result in little but unprofitableness. It may be asked, how is it possible to expect success without the conditions that will conduce to it?

In connection with the successful rearing of any animals, unless the necessary appliances are provided, and unless the attention paid to their wants is guided by a knowledge as to their requirements, success is out of the question. Experience has, however, proved that in the case of pigs, with proper housing, judicious feeding, and the exercise of care in breeding, it may in ordinary times be made a source of profit. These animals do not, of course, require to be fed with the primest of food: they will thrive well on the inferior or damaged corn with a few roots, and some other suitable coarse food which on most farms is available.

The breeding of swine has too often been looked upon with contempt and as beneath notice, so that whilst cattle and sheep have had the utmost care bestowed upon their breeding by thousands of skilful and wealthy agriculturists, pigs have been comparatively neglected. That much more attention should be paid to the selection of the breed than is at present the case,

no one can for a moment doubt. In my own practice I have repeatedly proved how much more profitable is a well-bred pig than a coarse inferior animal.

The Americans are paying the utmost attention to the breeding of pigs: a Herd-book has been established for the registration of pedigrees, and is supported by hundreds of breeders in the different States. When an American comes over to England to buy pigs, he will buy only of those breeders who can produce a well-kept record of pedigrees. If English breeders would, by a small additional outlay, commence with a good race, and pay the same attention to rearing and feeding as they do to other animals, they would well-nigh double the amount of meat produced, and this at little more than the cost of bringing their present ill-bred animals to maturity. Several cottagers in my own neighbourhood are fully alive to the importance of this matter, for they will give four or five guineas for a young sow-pig from good stock, rather than go into the market and buy one for half the price. Instances have come to my knowledge in which cottagers have thus made 20*l.* to 25*l.* during the year from the produce of one sow, with the keep derived mainly from their own garden and house-refuse, in many cases the housewife taking the entire feeding into her hands.

Before discussing further the subject of breeding, I would observe that some thirty years ago I was led to study the physiology of breeding through meeting with a remarkable book, 'Intermarriage,' by Alexander Walker, which, although devoted to the human family, contained valuable treatises upon 'The Application of the Natural Laws to the Breeding of Horses, Cattle, and Sheep.' In 1854 Mr. Reginald Orton, a medical practitioner of Sunderland, delivered two lectures to the Newcastle Farmers' Club upon 'The Physiology of Breeding,' in which he laid down certain fixed principles. Subsequent observations and experience have satisfied me that the principles laid down by Mr. Orton are sound; and although, like every other breeder, I know something of the uncertainties attending the breeding of animals, yet I am convinced that there are certain laws pertaining to the process, which, like all Nature's operations, are fixed and unalterable, and which cannot be disregarded with impunity.

From my own observation, from conversations with the late Mr. M'Combie, and comparing notes with other breeders, I have come to the conclusion that the following cardinal points in the art of breeding have been fairly established:—

1. That from the male parent is mainly derived the external structure, configuration, and outward characteristics—the locomotive peculiarities inclusive.

2. From the female parent are derived the internal structure, the vital organs, and, in a much greater proportion than from the male, the constitution, temper, and habits.
3. That the purer the race of the parent the more certainty there is of its transmitting its qualities to the offspring. Say two animals are mated; if one is of purer descent than the other, he or she will exercise the most influence in stamping the character of the progeny, particularly if the greater purity is on the side of the male.
4. That, *apart from certain disturbing influences or causes*, the male, if of pure race, and descended from a stock of uniform colour, stamps the colour of the offspring.
5. That the influence of the first male is not unfrequently protracted beyond the birth of the offspring of which he is the parent, and his mark is left upon subsequent progeny.
6. That the transmission of diseases of the vital organs is more certain if on the side of the female: and diseases of the joints if on the side of the male parent.

I could adduce numerous facts in support of these conclusions, but the following must suffice:—

First, as to colour. Twenty to thirty years ago the Duke of Bedford had at Woburn a herd of black sows which were always crossed with a pure white boar. I noticed on several visits that the young ones were all white. Since that period, on several occasions I have crossed Berkshires with a white boar, and the result invariably has been a litter of white pigs with scarcely a spot of black. A few years ago I paid a visit to the farm of the late Mr. Dumbrell, near Brighton. He had a very large herd of Channel Island cows. On remarking that he kept a Sussex bull, he informed me that his object was to obtain red calves, inasmuch as Alderney calves were unsaleable. Although the Sussex is not of so ancient a race, the calves invariably came red. With regard to the internal and external organization theory, the invariable result of crossing a mare with the male ass producing a mule, and the reverse method of crossing producing a mute, are perhaps the best proofs; but I have tried many experiments with poultry, more particularly with the Cochin hen and the game cock; I have bred many thousands from this cross: the result has been, without a single exception, an enlarged game-cock, and a hen which laid Cochin eggs. This theory has also been often confirmed in my personal experience in the breeding of both nag and cart-horses.

With respect to the practice of crossing, the difference should

always be borne in mind between the crossing of different breeds, and the crossing of different strains of the same breed. In the former case the result is necessarily a cross-bred animal; but in the latter the purity is naturally retained, with the manifest advantage of an introduction of new blood. Whilst the fact has been recognised that our improved breeds have all been established by the crossing of distinct races, the character of each of late years has been sustained and improved by selection and crossing of animals from the different strains of the same breed thus established.

The greatest claim that any herd or flock has to purity of breed may be computed by the length of time which has elapsed since its crossing with any other breed. The proof of recent use of any other breed in a herd will generally be seen in the progeny; if a cross has been recent, the characteristics in respect of colour, shape, and size of the progenitor will often obtrude. It is remarkable to note that, even after the lapse of twenty years, distinct features of a former cross will appear. This shows how much care and judgment are necessary in the selection of animals by breeders who care to maintain uniformity of character.

Some fourteen years ago, I was induced to buy a first-prize boar exhibited at one of our principal shows. He was a very perfectly shaped animal, and was declared to be out of a sow of my own breeding; but about his pedigree I was deceived. The result of his introduction into my herd was most disastrous, and not until the blood had been completely eliminated, did I get clear of his evil influence. In cases where, for stock purposes, breeding *in-and-in* is resorted to, the most vigorous of the litters of both sexes should be selected. Especial care should, however, be paid to the selection of the male. The late Mr. Fisher Hobbs was in his earlier career a most successful breeder of pigs. He used to boast that for twenty-five years he had never gone away from his own herd. Under such circumstances he had of necessity very often to breed from animals very closely related. His practice was to select the strongest of the progeny on both sides: by this means he obtained a few animals of great merit, but after pursuing the practice for some years, a large proportion of the litters were small, ill-shaped, and many of them deformed. If fecundity, freedom from disease, and strength of constitution are to be maintained, frequent change of blood is a necessity; for pigs, according to my experience, degenerate more rapidly from *in-and-in* breeding than any other animal. Where the maintenance of uniformity of character is a point of importance, as with exhibitors, change of blood should be introduced on the female side, inasmuch as the male has so

much more influence upon the outward appearance than the opposite sex.

With respect to the selection of sows for breeding, I would observe that the animal should possess size, this being a more important point than with the boar. The legs should be straight and short, the shoulders well outside, the chest thick and deep; the body should be of good length, with the back slightly convex so as to carry weight without drooping; there should be good width throughout, the ribs well sprung, giving rotundity, the loins and flank well filled up, the hams reaching as near down to the hock as possible: the tail should be long, but not coarse, set on nearly in a line with the back, and should have a good tassel of hair at the end. The head in a pig of the Large breed should be lengthy. Nothing is more objectionable than the head of a small-bred pig upon a large-bred sow. On this point I have long maintained that several well-known Judges at our Shows have been wrong; indeed, short snouts have become, or rather had become, a popular error, for I am glad to find that a reaction has set in. The head, I hold, should naturally correspond in length with the size of the pig; length of snout is one of the surest indications of rapid growth. There should be a good width between the eyes as well as the ears; the latter should be erect or only slightly pointing forwards, and of good length and fine. The collar or neck should be wide and well filled up; the skin should be fine and clear, denoting thinness; the hair should be abundant, long, and silky—a proof of good constitution and quality; it is also an indication of lean flesh. A sow should be a good milker and not have fewer than twelve teats; for milk to the young during the first few weeks is all-important: hence in selecting young sows for breeding it is highly desirable that they should be the produce of dams with good milch qualities. Brood sows should be selected from spring or early summer litters, inasmuch as they are generally better developed than those of winter litters. It will be obvious that the former have not only better weather for growth, but the advantage of field exercise and an abundance of green food, which all tends to promote the milch qualities.

Experience has taught me that sows should not be put to the boar before nine months old. I know this view is contrary to the opinion entertained by many who think that six months is old enough. In the case of the Large breed, I am convinced that the practice of breeding from sows too young checks their growth, and that the animal is not sufficiently developed or matured to produce a vigorous progeny; frequently upon noticing the weakness of a litter, I have discovered that, through an accident or carelessness, a young sow had been served before it

was intended she should be. I prefer putting sows to the boar in October or November; the litter will then come about March, and the sow will take the boar in May, so that her second litter will have become well grown before winter sets in.

With respect to the choice of a boar, I would remark that as the external form and locomotive organs are mainly contributed by the male, great care and attention must be paid to these features. The size I deem of less consequence than with the sow. A boar should possess a decidedly masculine character, should be active in his movements, have fire without ferocity, and should show breed both in form and carriage. Great importance also attaches to the feet and legs. The hoofs should be short and straight, the fetlock-joints strong, the fore-legs straight and well outside him, giving width to the chest. The hind-legs should be strong and not cow-hocked, the hams wide and deep, the testicles should be well beneath the thickest part of the ham and not too large, and not, as is too often seen, protruding immediately beneath the tail. Consanguinity should of course be as remote as possible.

In animals of both sexes special attention should be paid to the formation of those parts which produce joints of the highest market-value, a point not so uniformly insisted upon by Judges in our showyards as is desirable. A notable instance of the kind came under my observation at a meeting of the Royal Agricultural Society some two or three years ago. Two boars were exhibited in competition, one remarkably good in his back, loins, and hams; the other was comparatively mean and defective in these parts, but wonderfully good across his shoulders, and, as the saying is, "he met you well." The Judges put the latter first, the second prize going to the former —a boar which, although a year younger, was a very level perfect pig, and greatly superior to the first-prize animal in those parts which are of most value to the butcher. I may add this error of judgment was commented upon at the time by breeders as well as by the Press, and I should not again have called attention to the circumstance but for the importance of the principle involved.

No branch of the subject is of more importance than the management of breeding-sows. After being served, they should have plenty of exercise in a roomy yard or paddock; they should be fed with a little bran or pollard mixed with slops or wash from the house; in summer they should have green food—grass, tares, or prickly comfrey. I may mention that well-fed pigs, getting up for show, are exceedingly fond of comfrey—it is first-rate food for any kind of pig—it grows luxuriantly, and yields a constant supply throughout the summer. In winter, breeding

sows should have a few wurzel or turnips; but as they get near to farrowing, any green food must be given sparingly, particularly if the roots are at all frozen, and if frozen much, they should not be given at all. When within three weeks of farrowing, with a view to the secretion of milk, the wash or food should be improved by the addition of a little dan or sharps, and a little oatmeal may be added with advantage. It is desirable that the food should not be changed immediately before or after farrowing. When within a week or ten days of farrowing, the sow should be put into the sty in which she is intended to farrow, so that she may become accustomed to the place. The feeder should in all cases be with her when farrowing, and not a stranger, for the voice or manner of a stranger is at once detected, and often unsettles a sow, which frequently results in loss. Very little straw should be given within a week of farrowing, and that quite short. I do not recommend chaff or cut straw as some breeders do; I have found it a hindrance to the young during the first day or two, through sticking to their eyes and noses, whilst straw which has been trampled by the sows for a few days is both soft and warm, and presents no obstacle to the young pigs readily finding the teats. Numbers of pigs are lost through bedding with long straw just before the sow farrows. The indications of farrowing are very apparent, the teats fill with milk, the bearing or uterus presents a swollen and red appearance, hollows appear on either side of the tail, caused by the loosening or parting of the bones on either side of the womb-passage; the sow also collects all available litter into a heap, called "making her bed;" many sows refuse their food, and the appetite of all diminishes. Pigs, of all animals, require the least help during parturition, and the wisest course is to leave them to themselves.

As soon as a sow has farrowed, and the afterbirth has come away, give (if cold weather) a little chilled food, but feed sparingly for the first two days, adding to the food, after the first day, a little opening or purging medicine—say 2 oz. of salts and 2 oz. flour of sulphur, or 4 oz. red ruddle and 2 oz. of sulphur. This dose, while in nowise endangering a change in the milk, will keep the bowels open—a very necessary condition at this period.

The young pigs, as soon as possible after birth, should be examined, and any found with long sharp teeth, which teeth are often black, should have them taken off with a pair of nippers. The neglect of this precaution often causes the loss of the whole litter, and has led to the condemnation of many a good sow. The presence of these teeth causes the mother such pain in suckling that she becomes irritated, refusing to let her young

approach her, and often so furious as to kill and afterwards devour them.

Young pigs often lose their tails, especially in cold weather. This has been attributed to breeding *in-and-in*, and many other causes. Whatever may be the reason, I have found the following simple plan succeed in ninety-nine cases out of a hundred; indeed, only one tail has been lost out of the hundreds bred during the past three years. On the tail presenting an inflamed or red appearance, a little pure olive-oil should be applied with a feather every day until the symptoms have disappeared; in cold weather this practice should be adopted whether there is any appearance of inflammation or not.

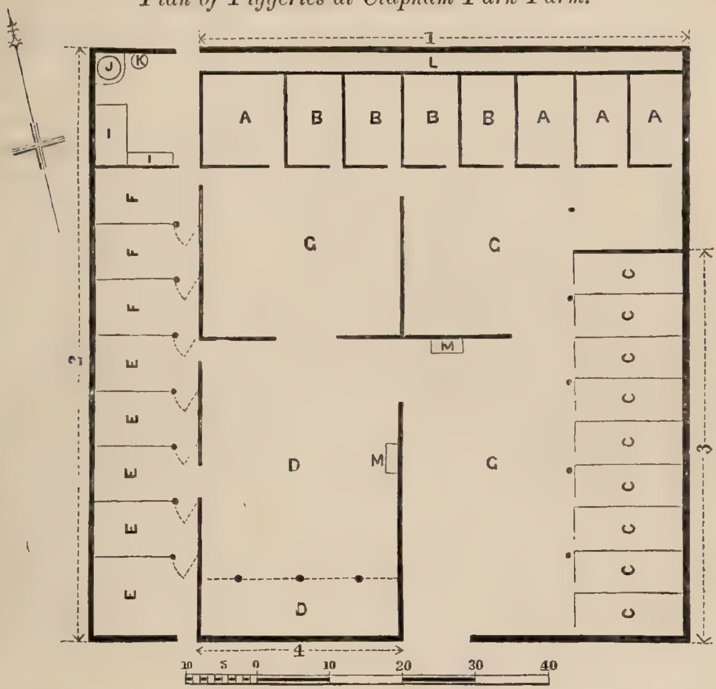
Sties used for farrowing should have a stout rail fixed all round them, about a foot high, and 9 inches from the wall or partition. This rail will prevent the sow lying on the young pigs, for they generally huddle together at the outside of the sty, and are thus protected by the rail. A fresh and roomy sty should be given at the end of a month; and the farrowing sty should be well cleansed, and remain vacant for about a week before another pig occupies it.

The young pigs, having had plenty of fresh air and exercise, having learned to eat and drink, and having gone on well while with their dam, may be weaned at 8 or 9 weeks old. If the weather is cold, they should be kept in a warm place, or they will miss the milk and warmth of the mother. As much skim-milk as can be spared should be set apart for the newly weaned pigs; their food should consist of an equal quantity of dan or sharps and bran, a little barley-flour and dust of linseed and cotton-cake, all well mixed and scalded in tubs with boiling water. It should stand for twelve hours, and then at each meal a little milk and warm water should be added to make it the desired thickness. Half-a-pint of white or any other kind of peas, if dry, may be given with advantage at mid-day. If the pigs are intended for pork, the diet should be improved by the addition of more meal; if kept as stores for breeding, the diet should be plainer, and green food or roots given. Store pigs should be ringed at three months; a very simple but efficient American appliance is now extensively used, the operation being almost instantaneous.

Fattening pigs require not only good food but regular and systematic feeding; therefore much depends upon the attention of the feeder. No food should be allowed to remain in the troughs. With respect to troughs, only in the case of boars and invalids do I ever allow one in a sty. Each pen of pigs is let out in turn to feed separately in the yard lettered D and G on the accompanying plan. The practice of allowing pigs to have access to food at any time tends to make them restless. I find

the following an excellent diet: equal quantities of bean, maize, barley, and wheat meals. To three parts of this mixed meal add one part of dan or sharps; if it is desired to push the pigs a little linseed-cake or spiced food may be added; scald it and use it as for young pigs. For Show pigs, and others when getting ripe, the practice of stuffing or ball-feeding is an excellent plan, and attended with good results. The plan pursued is as follows:—after each meal mix, according to the number of pigs, a pailful

Plan of Piggeries at Clapham Park Farm.



or two of the mixed meal with skim or new milk, and roll it into balls the size of an egg; have a pail with a little milk in it, so that each ball may be dipped into it before being offered to the pigs. After a few meals they will sit on their haunches and be fed like so many children. Each pig, after his meal of the thinner food in the trough, will eat about a gallon of the food in balls. Regular feeding is of great consequence, for if allowed to get uneasy and squeal for food, the animal makes little progress.

Although, as previously observed, the sow requires very gentle and careful treatment, especially during the period of pregnancy, the treatment of the boar is of still greater importance, and this

more particularly from the time when he is first used, inasmuch as his future temperament, whether kindly or ferocious, will depend very much upon the management and treatment he receives at this period. There should be firmness tempered with kindness; for these animals, from their nature often become unmanageable, if not dangerous, unless treated in a manner which common sense ought to dictate.

The young boars should be separated from the sows when three months old; from that age until they are fit for use, which I consider is not before they are eight or nine months old, they may lie together in pens of four, five, or six, according to their age and the size of the sty. After I have selected a boar which is to be used in the herd, he is from that period kept separate in order to avoid excitement. Until the boars reach the age of eight or nine months, their food is the same as that given to other young pigs: when in use as stock pigs, to their usual soft food is added a small quantity—say a pint twice a day—of whole corn, maize, beans, wheat, and barley mixed—soaked or boiled: in addition, a small quantity of green food or roots is given, according to the season of the year. As it is difficult to provide for yard-exercise where a number of stock-boars are kept, they are placed in sties sufficiently large to give them as much exercise as they need. Boars under nine months old have a regular turn of yard-exercise each day. The question of exercise for young boars is a very important one, as of course nothing will so much conduce to the development of their legs and feet, which, as already stated, are such important organs in the male animal. The practice of sawing off the tusks of old boars has been advocated by some, but I have always adopted the following method:—if necessary, the head of the boar should be secured, the tusk should be held tightly at the point to be broken off with a pair of blacksmith's pincers; a smart blow with a hammer on the pincers will sever the tusk without further trouble.

When a boar is needed to serve a sow, it is very desirable that he should be taken to a yard at a distance from any other boars, and some little time allowed to elapse before taking him back again. This plan will prevent the unsettling of the other boars.

I need hardly say that in the proper management of pigs as well as other animals, the success achieved very much depends upon attendants; the plan, therefore, of giving bonuses to the herdman is not without its advantages. A common practice is to give sixpence each for every three-months-old pig reared.

With respect to judging the age of pigs, much may be said in commendation of the Essay of Professor Simonds. He has

laid down certain general principles in respect of dentition, but observation and experience have proved to me that in pigs no absolute and unvarying rule exists. I have known great dissimilarity even in the same family, as I once demonstrated to the satisfaction of Professor Simonds himself. It is hardly necessary to allege that the development of dentition is retarded or advanced very much according to the health, constitution, and hereditary tendencies of the animal. This is an important matter for consideration as regards the public exhibition of animals, for, as is well known, instances of disqualification have occurred which have subsequently been proved without doubt to have been unwarranted. Quite independently of the question of dentition, pigs, like other animals, show indications of age; and an experienced breeder, in the case of young pigs especially, is able at once to detect a false entry in respect of age. Many herdsmen and breeders are able in a strange piggery to guess the ages at a glance, and this with great accuracy, as I have often witnessed.

Whilst on this point, I may say that exhibitors would do well to keep a careful register of the dates of birth and also of the numbers of male and female pigs in each litter. These entries might be attested by the breeder himself or his agent, and a second person, so that the breeding-book could be put in as evidence in any disputed case. If exhibitors were compelled, on dispute arising, to produce some such a register, it would go far towards checking the scandalously false entries which it is notorious a few exhibitors of pigs have resorted to.

As already stated, too little importance is attached to piggeries in respect of situation, arrangement, and general construction. Whilst aspect is not of the first importance, the situation should be well drained, and be such as to ensure plenty of fresh air and light, and as distinct as practicable from the other animals of the farm. The buildings, apart from the question of size, should be constructed to admit sufficient light and air for the summer, whilst at the same time there should be the means for readily adapting them to the requirements of winter.

A piggery should be easy of access for feeding purposes and the removal of manure. The matter of flooring is one of the most important considerations, and opinions are much divided as to the most suitable material. While asphalte is superior to any other as regards cleanliness, healthiness, and atmospheric influences, the smoothness of its surface renders it objectionable if not dangerous. In some cases wooden floors with small spaces are used, but in them there is the disadvantage of the ready absorption of moisture and the accumulations beneath, which so soon take place. I prefer a floor of gault or other hard

bricks laid with cement. Such a floor gives sufficient foothold to the animal, and at the same time resists the absorption of the urine; if laid with a proper fall the liquid quickly runs off.

The preceding plan (p. 217) will show the arrangement of my principal piggery, which, it will be observed, has a southern aspect.

Clapham Park, Bedfordshire, Feb. 7, 1881.

XVI. — *Jersey Cattle and their Management.* By JOHN THORNTON.

NEARLY two generations have passed away since Col. Le Couteur wrote an excellent paper in this Journal (vol. v. p. 43), "On the Jersey, misnamed the Alderney Cow." That paper gives full information on many points, but it does not give Col. Le Couteur the credit to which he is fairly entitled. It is to his efforts that the rise and progress of, and a great improvement in, the breed are mainly due. He acted as Secretary to the meetings in 1833, which led to the establishment of the Jersey Agricultural and Horticultural Society, and he continued its officer and mainstay for many years. The aim of the Society was to improve the native breed by careful selection, and in this way a race of cattle "as good as it is beautiful" has been established. Col. Le Couteur lived to receive the honour of knighthood, and to have the further gratification in his old age of seeing his work taken up by a competent and zealous successor. This was Col. C. P. Le Cornu; who, in his turn, has lived to see three young cows sold in the Island in one week for 200 guineas each, and to find the English and American public appreciating the labour and thought and following the steps of the Island breeders.

There can be little doubt that, by the rich soil and genial climate of Jersey, a native breed of cattle, originally of a similar character to those of Brittany and Kerry, has been fostered into a special excellence, which the pastures of the north-west of France and Ireland could not impart. A feeling of the inhabitants against the French cattle seems to have prevailed for generations. One of their earliest historians, the Rev. Philip Falle, as far back as 1734, wrote that "the cattle of this island are superior to the French," and Thomas Quayle, in 1812, considered that "the treasure highest in a Jerseyman's estimation was his cow." The same spirit that now exists among the farmers of the Island to preserve the purity of their breed, doubtless actuated their forefathers a century ago. Acts of the States of Jersey were passed in 1763, 1789, 1826, and 1864,

prohibiting under heavy penalties (200*l.* and confiscation of the cattle and boat) the introduction of cow, heifer, calf, or bull from France. These Acts did not prohibit the importation of English cattle; both Shorthorns and Ayrshires were introduced, yet their milk and butter were thought so thin and poor that they were looked upon as inferior to the native cow, and eventually found their way to the shambles. Although purity of breed was the farmer's first consideration, yet there is no record to show that any systematic attempt at improvement was made, except that the male progeny of a cow which was famed as a good milker was preserved. The number of Alderney cows that existed in the South of England upwards of a century ago, is evidence that there was at that time a trade with the Island for them. The Act of 1789 states in its preamble that the trade is one of the most profitable branches of the commerce of the Island with England, and it was a common saying for an indifferent animal in Jersey, that "she was good for England." Mr. Michael Fowler commenced business as an importer in 1811, and his three sons now continue it. He is said to have talked much of the cattle and shows of Yorkshire, his native county; but no attempt to establish a society in the Island was made until 1833, when a meeting of the Lieut.-Governor and 25 gentlemen and farmers was held. Rules and regulations were agreed to, and it was resolved that the encouragement of agricultural and horticultural improvements, and of improving the breed of cattle would conduce to the general welfare of the Island. In 1834 a scale of points for governing the Judges at the Shows was drawn up; for bulls there were 7 articles, to which 25 points were allotted, and for cows the same number of articles, to which 27 points were assigned. In 1875 these were extended to 25 articles and 100 points for both bulls and cows. Records of the appearance of the cattle at that time exist at the present day. They were shown much out of condition, having the head coarse and ill-shaped, being fleshy under the throat, heavy in the shoulders, and with ears without that golden tinge denoting rich produce. They were too slightly formed behind, drooping in their hind quarters, and cat-hammed; the udder was ill-formed, the tail coarse and thick, and the hoofs were large.

Many were the difficulties which Col. Le Couteur and his successor, Col. C. P. Le Cornu, encountered. The income of the Society was very small, no great result came from the Shows, and the States grant of 100*l.* was withdrawn in 1842. Still Col. Le Couteur persevered, and at one of their public annual gatherings said, "He would tell those who were lukewarm to the Society to look back ten years. The land foul with weeds, crops in-

ferior, liquid manure wasted, the market ill-supplied. What had been effected? In cattle, beauty of form and flesh had been added to milking and creaming qualities, more cattle had been decorated than on any previous occasion, and the breed had so greatly improved, that many of the animals rejected would have been prize-cattle when the Society was formed. The price of cattle had fully doubled."

In order to encourage breeding from superior animals, new rules were enacted, to the effect that any person withholding the service of a prize bull from the public should forfeit the premium; that no person should receive a prize for bull, stallion, or boar until the animal had remained in the Island at least one whole season after the prize had been awarded; and that all heifers having had premiums adjudged to them should be kept on the Island until they had dropped their first calf; if previously sold for exportation, they should forfeit the premium. These rules became necessary, for prices began to increase. When the Royal Agricultural Society of England held their show at Southampton in 1844, the Island Society gratefully acknowledged the liberal grant of premiums given by the Royal for "Channel Islands or crumpled horned cattle," and added half the amount of the awards as additional premiums to the owners of the prize animals in each class, calling special attention to the above new rules. A marked difference at this show was observed between the Guernsey and Jersey breeds, "the latter being altogether of a more delicate and slight form." This difference eventually became such a bar to the Judges, that in 1863, a petition—signed by the President, Secretary, and officers of the Society, and Mr. Dumbrell, of Brighton—was presented to the Council of the Royal Agricultural Society of England, recommending that Channel Islands cattle should form separate classes. After a lapse of eight years the request was granted in 1871, when the Show was held at Wolverhampton.

The great prosperity of America in 1853 led to animals being bought for large sums and sent to the United States; this continued more or less until 1870, when animals were sold for higher prices than had hitherto been realized. Thirty-one animals were purchased at one time for 995*l*. for exportation to America. The following year Col. Le Cornu sold an extraordinarily fine heifer for 100 guineas, the highest price that had been realised. These sales were viewed with some alarm by the Board of Management of the Island Society, who called special attention to the impolicy of selling for exportation the greater number of the cattle which had obtained prizes. They showed that the only means of keeping up the reputation of the breed,

preventing its deterioration, eradicating its defects, and perpetuating and increasing its excellences, were only to be obtained by selecting the finest and most perfect animals for reproduction, resolutely rejecting from the breeding stock every animal in which defects were to be found; "like producing like being a maxim which every breeder must ever keep in view." The growing taste for animals of a whole colour was also deprecated. This was first shown by the Americans, and later by English buyers, especially after Mr. Dauncey's great sale in Buckinghamshire, when 90 animals realised 3737*l.* 9*s.* 6*d.* In their report to the members of the Society, the Board thus protested: "Let henceforth such fanciful ideas as black tails and black tongues be simply estimated at their proper value; but let the large and rich yield of milk ever be the breeder's ambition to procure." They also impressed on farmers the necessity of selecting bulls *only* from the best and richest milkers. Some fear was at first felt by the Board at the rise of cattle-shows in the various parishes. Jersey is divided into twelve parishes; and in 1852 St. Peter's and St. Owen's formed farmers' clubs and held local shows. These, far from injuring, only swelled the shows of the parent society, which was increased by upwards of one hundred entries. In course of time the States' grant was renewed, and it now amounts to 150*l.*, of which 100*l.* is divided in prizes of 10*l.* among ten parishes, and 50*l.* in prizes for bulls. In Jersey, bulls were looked upon as expensive animals to keep; for they are kept generally in very high condition, and the prize bull of a parish becomes in truth a parish bull. It is no uncommon thing for a first-prize animal to serve upwards of 300 cows during the season, consequently they are rarely kept over three years old; by some this is attributed to the viciousness of the animal increasing with age, but undoubtedly the true reason is unfruitfulness.

The origin of recording pedigree, and eventually of the Herd-book, was as follows. A few years after the first show was held, the produce of prize animals came to be exhibited; and in 1838 points were first given for pedigree, which meant "the offspring of a prize or decorated male or female stock." Col. C. P. Le Cornu saw, as years passed by, the necessity of a further classification of animals. The result of his inquiries into the system of the English herd-books was not at all in accordance with his own ideas, which were to divide stock into three classes—highly commend the best, commend the second best, and reject the inferior animals. After great opposition, he at last succeeded, in 1866, in getting a meeting held to take steps for the formation of a Herd-book. He placed the advantages of his system—to select and breed from

the best—before the country at meetings of the several parish farmers' clubs, and excellent papers on the subject appeared in the Society's annual reports. It was proposed to examine all stock from which produce in the future was to be registered. The first examination was held at St. Heliers. Six Judges were appointed. Breeders and owners brought up their animals; a separate staff of men was appointed to bring them before the Judges to be examined. Members of the Agricultural Society were charged a fee of 6*d.*, non-members 2*s.* 6*d.* Numerous examinations took place, and those animals highly commended and commended were entered and numbered as foundation stock. Pedigree stock was the offspring of animals entered as foundation stock; and strict regulations were enforced as to the date of service,—date of calf's birth and other information being recorded in the Society's books. Consequently, the number of animals that came up for examination as pedigree stock was comparatively small; for some breeders did not comply with the strict regulations, whilst others, tempted by the high prices offered for the produce of foundation stock for exportation, sold them before the examinations took place. It was therefore resolved to open the foundation stock again in 1873–4, with a fee of 5*s.* for approved animals. The demand for pedigree stock by the Americans and English, and the increase of prices, awoke the Jerseymen at last to a sense of the value of pedigree. They sent up their stock by hundreds for examination, even at the 5*s.* fee, and Col. Le Cornu had the pleasure of finding a balance in the hands of the Society of nearly 200*l.*, whilst the first year had left him fifteenpence halfpenny out of pocket. The first volume of the Herd-book was published in a tabulated form in 1873, and the second volume came out in 1874, the foundation bulls standing at 196, the cows at 1441. The pedigree stock recorded numbered only 64 bulls and 52 cows. During the next three years 175 bulls and 185 cows only were examined; the small number being again attributed to the "temptingly high prices" offered for the young animals of foundation stock. The effect of fashion in colour was also apparent; for the report stated "that quality forms the leading point to which the judges attend: fanciful ideas of colour form no part of the examination, though it is remarkable that an increasing proportion has taken place in the number of self-coloured bulls and heifers." Disappointing as the number of pedigree animals may have been, the Committee had the gratification of receiving a petition signed by sixty-three breeders, praying that the foundation stock might be re-opened for two more years. This was granted, on condition that the fee for approval should be 10*s.* instead of 5*s.* Numbers flocked up for examination, and the funds now

stand at over 500*l.*, whilst the fourth volume, just issued (1880), brings the numbers to:—foundation stock bulls, 320; cows, 2223; pedigree stock bulls, 223; cows, 312.

It will thus be seen that an animal entered in the Island Herd-book is about equal in personal merit to one receiving a prize or commendation at one of our shows. No weedy or defective animal, although the offspring of excellent parents, is allowed to be entered; so that, however long the pedigree of a registered animal may be, the stranger may rest assured, that, unless meritorious, it can have no place in their Herd-book. Assurance of this will tend greatly to encourage the value of the Island pedigree stock in the future, and the system is one commendable to the notice of members of Herd-book societies in this country. For the forced and obese state in which prize animals are seen at our own Agricultural Societies, from the Royal downwards, distinctly tends, except in very few instances, to the deterioration, and not to the improvement of our British breeds. Our Herd-books simply record the produce of bulls and cows. They give no assistance to the uninitiated in discovering the merit or defect of the animal recorded. Thus our great national Agricultural and Herd-book Societies, with large funds at command, though working directly for the improvement of the British breeds, are indirectly encouraging the unnatural forcing of animals on the one hand; whilst on the other, the propagation of highly-bred offspring, from parents often weedy and delicate, is in no wise checked.

Special prizes are given at the Island shows for a system comparatively unknown and somewhat ridiculed in this country. This is the Guénon system, and prizes are awarded to both the bulls and cows showing the richest types. The system has been known and practised for more than half a century in France. Francois Guénon, a poor studious lad, whilst tending his milch cow in his native province in France, observed a growth of the hair above the udder the reverse way, and he noticed that when this hair was scratched a kind of bran or powder fell from it. He reasoned that as plants had signs for their good or bad qualities, there might be analogous signs in the animal kingdom. He examined other cows; and concluded, from the various sizes, ways, and forms in which the reversed hair, now called the escutcheon, grew in these parts, that the good or bad milking properties of animals might be ascertained even before they calved. After long and wide experience, he arranged animals into three groups—large, middle, and small size. He divided the escutcheon signs into eight orders, subdividing these again into eight classes, and found that he could determine the quantity and quality of a cow's milk daily, and the longest

and shortest time she would hold it. His system was pronounced infallible by the Agricultural Committee of Bordeaux in 1837, later by other Agricultural Societies, and he was honoured and rewarded. Those also who have recently studied the intricacies of the system pronounce it a most excellent guide in estimating dairy properties; and, though introduced into the Jersey shows so lately as 1874, it is rapidly gaining adherents, and breeders are qualifying themselves to judge by it. In America the system has also received considerable attention.

Having thus endeavoured to show the manner by which the Island breeders improved their native cattle, it is necessary to show the progress which the breed has made in this country during the present century. As far back as 1794 an experiment was tried in Kent between a large home-bred cow, doubtless a Suffolk, eight years old, and an Alderney, two years old. The cow in seven days gave 35 gallons of milk, which made $10\frac{1}{2}$ lbs. of butter; the Alderney 14 gallons, which made $6\frac{1}{2}$ lbs., or more than double the amount of ounces of butter to the gallon of milk. In writing the history of the Jersey cow in this country, it is difficult to distinguish between the Jersey and the Guernsey, and even the Brittany; for all the Channel Islands cattle bore the common name of Alderney, an island that supplies a very small number (scarcely a hundred annually), and whose breed now, by the use of Guernsey bulls, has become larger and coarser than the fine deer-like Jersey. The difference, too, between the Jersey and Guernsey has become very much more marked of late years, both in size and colour, and particularly the head, horns, and nose. The Jersey is the smaller animal, finer in its limbs, neater in its frame, and more thoroughbred-looking in appearance; the horns are thinner and more crumpled, the face finer, slightly concave, and more docile and intelligent in appearance. The eye is bright, black, often with a white rim, and the muzzle intensely black, also with a light-coloured rim round it. This is one of the most striking differences between the Jersey and Guernsey, the latter having usually a flesh-coloured or stained nose, and a lightish yellow and white body, being larger of stature, and coarser of limb. The yield of milk too is larger in the Guernsey, yet there is little, if any, difference in the yield of butter; indeed, some contend that the Jersey will yield more butter, and is a smaller consumer of food. Be this as it may, there is no question as to the Guernsey giving the larger yield of milk; and when large yields are spoken of as coming from an Alderney cow, it is more often found to be from a Guernsey than a Jersey. Guernsey cows have occasionally been taken into Jersey; but crosses between the breeds have not been successful; the yellow colour

and pink nose usually crop up in the offspring, which retains a coarseness at once detected and rejected by the Island judges.

About forty years ago, when the duties were altered, and later, French cattle were shipped to England with the Island cattle, and passed off as Jerseys. Hearing of this, the Island breeders became very vigilant. One man was reputed to have made about 1800*l.* by this traffic; for in Brittany cows could be bought at about 5*l.*, and they were sold here, according to their merit, for 15*l.* and upwards. Even now Brittany cows may be purchased along the coast about St. Malo for 8*l.* to 10*l.*, and much resemble inferior Jerseys. The udder is not so good, nor is there such a generally well-bred appearance as in the Jersey. The quarantine of French cattle, now enforced at Southampton and other ports, is sufficient precaution against this trade being continued.

Mr. George Culley, the great Northumbrian authority on cattle, in his 'Observations on Live Stock,' 1807, considered the Alderney breed scarcely worth the trouble of naming at all, as he imagined them too delicate and tender ever to be much attended to by British farmers. "They were only to be met with at the seats of our nobility and gentry, upon account of their giving exceeding rich milk to support the luxury of the tea-table." Yet he admits having seen some useful cattle bred from a cross between an Alderney cow and a Shorthorn bull. It is only of later years that the breeds have been kept pure, for, as previously shown, at their first introduction it was the custom to keep one Alderney to two or three dairy cows, to enrich the milk and colour the butter. Even now, in some parts of the country, this practice is still continued; for some epicures consider both the cream and butter made entirely from the Alderney to have a fatty greasiness in flavour, distasteful to the refined and delicate palate. Much, however, of this may depend on the manufacture of the butter and the taste of the consumer.

The herd at Audley End, Mr. Selby Lowndes', Mr. Dauncey's in the south of England, and the Rev. John Hill's in Shropshire, are among the very few herds that have been kept pure for upwards of half a century. To Mr. Philip Dauncey is, however, due the honour of bringing the breed into greater prominence; creating a demand for it and setting the fashion for whole colours. He went to reside in Buckinghamshire in 1821 and kept a Suffolk cow, but seeing a "little lemon-fawn cow with white round her nose," near Watford, which took his fancy, he purchased her. The Suffolk gave 21 quarts a day, the little lemon-fawn cow, "Pug," 11 quarts, yet her butter yielded $10\frac{1}{2}$ lbs. against $10\frac{1}{4}$ lbs. from the Suffolk. His choice of a breed for dairy was soon made. Many interesting anecdotes are told regarding

the selection and formation of his herd. He used "Pope," an Island bull, in 1826, and occasionally one of his neighbour's (Mr. Selby Lowndes'), but he relied mostly on his own blood, weeding and rejecting for upwards of thirty years, when he took another direct Island cross. In management he adopted the English method of not putting his heifers to service until about two years old; and, on account of the increased price of winter butter (by which he made about 1000*l.* a year from 50 cows), he preferred his cows calving in autumn and winter. He certainly created a type which took the public eye, and many a breeder now dates his taste for the breed, apart from the butter question, from having seen the beautiful deerlike creatures in "Dauncey's meadows, when hunting Whaddon Chase."

An eye-witness has left a vivid picture of them:—"Mr. Dauncey has been a breeder rather than a buyer, in which way he has acquired more size and constitution; but, together with the higher development of these qualities, an unmistakable coarseness is apparent. In going through the herd the first thing that struck the visitor was their fine size and level looks. There were but few of those ragged razor-backed bags of bones, so often supposed to typify good milkers; but most of the cows carried some flesh, with thick kindly coats, and other such attributes of the hardy healthy animal. Imposing as the Horwood Alderneys looked in their standings, they improved immensely upon the eye when led into the ring. What with their free, graceful carriage and kindly, placid manners, they bore about them the very impress of highly-bred but not over-bred animals. Long and low, level but not flat, their symmetry and condition were equally admirable. No wonder the Squire is loth to part with them now that he has fashioned them, as it were, all of a family, for to sketch one is to portray the whole herd. The same dark pointing of the same sober garments is the very livery of the tribe, set off by the gamely-tanned muzzle, the bloodlike necks and light deerlike limbs and movements. When the coarseness does crop up we note it in a thick, ungainly, and often gaudy horn, or yet more in the harsh, awkward setting-on of the tail."—*Mark Lane Express*, Oct. 28, 1867.

The late Mr. Duncan's herd, in the same county, was somewhat similar to Mr. Dauncey's herd. It was bred for over thirty years for whole colour, and the animals became rather smaller in size. The cows calved mostly in the spring months. Mr. Duncan's annual profit in dairy produce was about 23*l.* for each cow. The average price realised, 40*l.* 5*s.*, when the herd was sold in 1873, fell just below Mr. Dauncey's. It numbered

but 44 head, against 90 sold at Horwood in 1867. Mr. Marjoribanks's herd at Bushey, collected at some pains and cost, was bred with a view to combine beef with the dairy qualities; the public did not appreciate it, and a year later, when times were good, only appraised it at 35*l.* 6*s.* each for 45 head.

It can scarcely be said that the Jersey breed, or rather Channel Islands cattle, except on two or three occasions, had formed a feature at any of our agricultural societies previous to 1871, when the Royal divided the Jerseys from the Guernseys, and the Bath and West of England followed suit a year later. Yet in 1844, when the Royal Show was held at Southampton, 12 bulls and 10 cows and heifers were exhibited; three, out of the four, prizes being awarded to animals bred in Jersey. The remaining prize (in the Aged Bull class) was given to a Channel Islands bull, bred by the Rev. W. Phillips, of Southampton. The Show was nevertheless so good that Mr. Bates and other eminent breeders expressed their great admiration of the animals. At Windsor, 1851, there was another good show. Thirty-one animals competed, and all the prizes were won by English animals, except that for cows, which went to a Guernsey. Mr. Dauncey sent some of his animals to Windsor, but the Judges only commended two of them, considering them too large for the breed. At Battersea, 1862, there was a large show of 20 entries, described as "Jerseys, commonly called Alderneys." Two years later, at Newcastle-on-Tyne, there were 19 entries, and Mr. Dumbrell, of Brighton, carried off six out of the nine awards. Plymouth brought out the largest display hitherto seen; 53 animals were shown, and every prize was taken by Island breeders. At Leicester, 1868, 38 animals came out. Here, as at Plymouth, the Island breeders took every prize that was awarded. In 1870, at Oxford, Col. Le Cornu and Mr. Morgan being Judges, there were 57 entries; three prizes fell to the Island, one to Guernsey, and five to English breeders. Mr. Dauncey's cow, "Vixen," was the first, and his "Spiteful" the third prize winner.

In 1871 at Wolverhampton a final separation took place between Jerseys and Guernseys, and since then it has been pretty well an open question whether our own or the Island breeders won. Local shows began to give more encouragement to the breed. The Bath and West of England and the Hants and Berks Societies had large entries commencing with that year. Lord Chesham, Lord Egmont, Mr. Cardus, Mr. Drewitt, Mr. Wingfield Digby, Mr. Dixon, Mr. Fuller, Mrs. Malcolm, Mr. Rigg, Mr. Ramsden, and Mr. Simpson, have been the principal winners. The Essex Society has also had good and numerous shows, and the prize-list has been swelled by special

prizes given by county breeders. It was about this time that Mr. Walter Gilbey's name became noticeable as a successful breeder and exhibitor; and for the next four years, until he was suddenly compelled by the death of the owner to leave his residence and sell his herd, he may be said to have carried all before him. His success is, in a large measure, due both to management and selection. Being a great advocate for having one stall in a London stable kept for the use of a cow, he began, years prior to exhibiting, to keep a good "Alderney" for his family use. Finding a great difference between one cow and another, he gave more attention to the selection of them. The taste growing, he kept a larger dairy at his country residence in Essex. In time he found a demand for the offspring of these animals, as they became famous for their great yields of milk and butter. The best and choicest imported animals, regardless of colour or price, were sent to him; and he also made selections among herds in his immediate neighbourhood, where Lord Braybrooke, Mr. John Archer Houblon, and Mr. Cornwell, had long given attention to the breed. He found, particularly among the Americans, that the inquiry was mainly for whole-coloured animals. Having got the milking properties to the greatest perfection, by sedulously drafting cows with defective udders and indifferent yields, he sought to introduce whole colours, not so much for his own taste as for that of the public. As Mr. Dauncey had studied both milk and colour, Mr. Gilbey selected his "Ban," a three-year-old in-calf cow, considered by most people the best in the sale; she cost 81 guineas (the second highest price), Mr. Marjoribanks having given 100 guineas for "Landscape." "Ban" on coming to Mr. Gilbey produced a heifer-calf; and for nine months was kept idle in order that she might be put to "Rioter," a bull of Mr. Dauncey's, to breed a bull for his own stock. The produce was the celebrated "Banboy," first-prize bull at the Royal at Wolverhampton, where also Mr. Gilbey's cows, "Duchess 14th," bred on the Island, was first, and "Milkmaid," bred by Mr. G. A. Fuller, near Dorking, third. Banboy, bred right on both sides for milk and colour, retained the dairy properties, and imparted whole colours to his progeny. With these, however, came a certain degree of coarseness, which was obviated by turning the heifers, when about nine months old, with a young bull of the same age, into a large barn. The animals showed inclinations to breed long before they had hitherto been mated, and by mating them early, they were set breeding, and their milk-vessels kept shapely and perfect. The calves were kept on the heifers for six weeks, and gradually weaned; but calves from cows were brought up by hand and taught to feed early, yet not forced.

To the heifer the most particular attention was paid; her milk was often too rich for the calf, and her feeding was regulated by her work. If she had to support a calf, to give much milk besides, and to carry another calf within her, she was generously fed; but immediately the milk began to fall off, the diet fell off too, and this practice was adopted generally with the herd. Warmth was considered as essential as food, and a little cake was given in extremely cold weather. Exercise was also looked upon as most important; the old people of the village, unable to work, earned a few shillings weekly by leading out a cow to walk both before and after calving. To this practice was attributed the result that no cow dropped, or rather fell, with milk-fever. This tendency the Island breeders overcome by the system of tethering. The bull often commenced service when nine months old; he was well kept, though lean, as a lean animal was preferred to a fat one for use. Mr. Gilbey considers the gain of a few months in the calving of heifers of great importance. It had doubtless been a source of profit to Island breeders, for he observed that many of the imported animals evidently calved down long before they were two years old. Profit was the object of the Islander. The shippers and dealers who formerly brought over cows had frequent complaints from purchasers of bad udders; in consequence inquiries arose for in-calf heifers, and it thus became the Island breeder's object to get his heifers with calf as soon as nature and prudence permitted. Mr. Gilbey's herd came to the hammer on a snowy December morning in 1874. It attracted buyers from all parts, and general admiration was expressed at the beauty of the cattle. This admiration spoke in golden accents after the sale, for the 50 head realised 3240*l.* The 18 cows averaged 90*l.* 16*s.* 6*d.*, and 255 guineas was given for a cow, and also for a heifer. Another made 215 guineas, and a third, "Milkmaid," went to America at 155 guineas, where she afterwards became one of the most celebrated animals in the States.

The mantle of Mr. Gilbey's success has fallen on Mr. Simpson, of Wray Park; who has kept a herd for about eighteen years in Surrey. He selected, like Mr. Gilbey, the choicest animals, either from Island or home-breeders, whenever opportunity offered. His system of management and rearing differs somewhat from that practised in Essex. He objects to heifers calving under two years old; for, unless rested three or four months, he finds a tendency to calve the second calf prematurely. For three or four weeks before calving the cow or heifer is placed in a loose box, gets oat straw to eat, and is walked out daily. Immediately the calf is born, the cow has a rug placed on her for twenty-four hours or more, according to the time of year. She receives a

dose of medicine, chiefly salts and bran mashes, and is kept low, being moved about occasionally to relieve the bowels. In two or three days she gets hay and a little powdered cake. The calf is found to do better if allowed to remain running with the dam a week or ten days, but the cow is milked daily. Afterwards the calf gets new milk three times a day for about three weeks, then two parts new and one skim. Oatmeal gruel is then given with about five quarts of milk, and the calf is gradually taught to eat with powdered cake and fine hay. The gruel is thinned until water is substituted; and the calf is allowed to run out in a paddock in good weather, coming in once a day to feed and rest, for by galloping about when so young they are apt to run off flesh. In winter they live in large boxes or barns. Rock salt is put into their mangers as well as a few lumps of crumbled chalk, which they readily lick. Tucker's pails are used for feeding; and by preventing a large quantity of fluid being drunk at once, blowing and indigestion is saved. Scour, which frequently comes on, is relieved at once by giving a tablespoonful of linseed oil, and an hour afterwards a teaspoonful of bicarbonate of potash dissolved in water. These remedies break up the curd which causes the irritation in the bowels.

The cows go out in all weathers when the land will carry them. They are kept in a shed with a moveable front, which can either be taken away in hot weather or closed in cold. Windows above are kept open day and night, except in extremely severe weather; for the yield of milk is, in a great degree, regulated by the warmth of the animal. Mr. Simpson believes in rearing young animals well, and keeping both cow and bull with a plentiful supply and occasional change of food. Roots, turnips, mangolds, carrots and parsnips, with hay, straw, and chaff are allowed; ample exercise is given. Cows are kept from service until the eighth or ninth week or third period after calving; and much stress is laid on the benefit of injecting a weak solution of Condy's fluid or carbolic acid soon after parturition.

The quantity of milk given is weighed. This has been found a more accurate method than measuring, for men, however careful, are apt to be misled by the froth. 10 lbs. weight are equal to 1 gallon imperial measure, and 1 lb. of butter can ordinarily be made from about 15 to 17 lbs. of milk. One of Mr. Simpson's best cows gave, after calving her second calf, from April 10th to the end of February, 9202 lbs. of milk; whilst another cow, seven years old, after calving January 21st, gave the week ending February 20th, 284 lbs. of milk. From this, after standing thirty-six hours in shallow vessels,

16 quarts of cream were taken, and 16 lbs. 5 oz. of butter was churned.

At Audley End a herd of Jerseys has been kept pure by Lord Braybrooke and his predecessors since 1811. By the use of English-bred bulls and the system of management, the animals are on a larger scale than those bred in the Island. Heifers calve their first calf at about two years old, and are allowed to rest for about four months before another service; after the second and other calves, about nine weeks are allowed to elapse. It is considered that the heifer by being rested developes her milking properties and increases her growth and strength. Calves suck their dams for about ten days, and are afterwards put on new and then on skim milk till about three months old, when the milk is discontinued, and pulped roots, bean-meal, and linseed-cake and hay are given. They have free access to water. They are kept indoors in the winter and run out during the summer, but are brought into an open shed at night. After nine or ten months old they remain out according to the season, and get a little bean-meal, crushed oats, and mixed corn and linseed-cake, with hay and occasionally clover chaff. Pulped roots are given, with straw and hay chaff salted, crushed oats, desiccated grains, and malt culms. Parsnips were used, but they invariably proved an unsatisfactory crop, and carrots have been grown instead. When the root-crop is short, brewers' grains are added to the other food. The milk is measured; one cow, after her fifth calf, gave in forty-eight weeks 900¾ gallons, and the herd of twenty-eight in milk, during the year 1880, averaged about 11½ gallons per head per week.

Lord Chesham's herd at Latimer, Bucks, has been in existence upwards of a quarter of a century. Island cows were first bought, and bulls of the Dauncey and Duncan blood used. When the fashion for the French or silver-greys set in, some of the best cows of that colour were purchased, but there seems to be a tendency in the soil and climate to grow the produce with more size and hair, and they become of a dark-reddish fawn colour. About thirty cows form the dairy, which is especially studied, and a large quantity of butter supplied, at a standard price the year through, to a West-End London tradesman. One feature in the management at Latimer is that no roots of any kind are given: they have been tried, but the different flavour in the butter has at once been detected, and a request made for their discontinuance. No long hay is given, as it is apt to be wasted; it is all chopped, mixed with linseed steeped in water, and, after fermenting twenty-four hours, is given to the cattle and readily consumed. 3 or 4 lbs. of cotton-cake increases and enriches the milk, but care has to be exercised in getting

it pure. If any cow is thin and weakly, 2 lbs. of oilcake is allowed daily, and the absence of milk-fever is attributed to keeping the cows up three weeks before calving, giving them dry food and a weekly dose of salts and sulphur. After calving, bran mashes are given for a few days; then hay chaff and the usual food. They are tied and milked in a house, but turned out afterwards into a large three-parts-covered straw-yard. The calf sucks the dam for a fortnight or three weeks; bull calves are allowed to remain longer. When separated these go into a partially-covered yard, and are gradually weaned with warmed skim-milk and artificial food. They then get chopped hay, with barley, pea, bean, or oat meal, and a little oil-cake. Bulls are similarly kept, but a trifle better, and walked out daily. The system of putting heifers to at twelve months old was tried, but the produce was so small and the heifers became so weakly that it was not followed up: now they generally calve at two years old. Animals intended for exhibition receive about 2 lbs. of linseed cake daily for a few weeks previous to the show, and are well cleaned: a number of premiums have been won. The animals show an aptitude to feed when dry, and barren cows have made 18*l.* to 21*l.* in Watford Market.

In Hertfordshire a large number of Jersey cattle are kept. Mr. Barnes's system of management prevails in the neighbourhood of Watford, and the demand for his butter is very great, prizes having been won with it. The herd of Jerseys, bred principally from Lord Chesham's and imported stock, has been kept some years, as well as a small herd of Shorthorns. His method is to bring the cow into a box a fortnight before calving, and give her a drink of salts, ginger, nitre and ale. As soon as the calf is born a handful of salt is sprinkled over it and the dam licks and strengthens it; if weakly and unable to suck, a little milk is trickled down its throat, and it is allowed to remain with its dam two or three days. Jersey milk is considered too rich, and the death of many calves is attributed to it. The dam is clean milked, drenched, and a pailfull of warm oatmeal gruel given her, and for four days her food consists of bran mashes. Lukewarm water is also given, and the udder is drawn three times a day. At the end of a week she may be turned out for an hour or two in fine weather. The calf is fed three times a day until a week old with about a quart of warmed skimmed milk. The quantity is then gradually increased, but never exceeds two gallons a day, and the calf, if kept with others, is tied up both before and after feeding. The desire to suck something is gratified by giving a small piece of linseed cake; and bran and bruised oats, mixed with linseed-cake dust, are given as soon as the calf will eat. At two months old the

calves are let out into a paddock for an hour or two daily; longer as they grow older, particular attention being taken not to allow them to go out before the dew is off the grass, and to take them in during the heat of the day in summer. In cases of scour a tablespoonful of castor-oil is given at night, and a tablespoonful of carminative chalk in the morning. In the autumn a little hay is given at night with bran and cake; but it is considered a great mistake with Jersey cattle to get them fat with new milk when young; they grow coarse and lose the quality and beauty of the breed. Later in the autumn a few carrots or swedes are given pulped with hay-chaff, and they do better if allowed to run in a loose shed with a yard during winter. In this way the heifers become accustomed to the cold climate and as hardy as other breeds of cattle. They are put to service at about fifteen months old, so as to calve at two years old, but no cows are allowed to calve in June, July, August or September. The cows are kept moderately. They have grass in summer and a little hay in autumn, with the addition of grains, roots, and a little decorticated cotton cake as winter comes on. Roots often cause an unpleasant flavour in the butter. Hay and straw chaff mixed with bran and boiled barley cause a great increase of milk and do not taint the butter. The barley is boiled until it bursts, and the hot liquor is poured over the chaff-mixture and allowed to stand twelve hours before being given to the cows. The same man milks the same cows night and morning, and care is taken that he be quiet, cleanly, and good-tempered. It is preferred to let the bull run with the cows, but as this is often impracticable, he is kept loose in a box with a yard to it, and the cows are turned in for service. If it becomes necessary to tie him up, he is walked out at least one hour daily. He is kept low in condition if not much worked.

Hampshire and the Isle of Wight have long been the home of the breed. The bulk of all the cattle shipped from the Channel Islands come to Southampton, and therefore cows can be purchased without much additional cost of carriage in transit. They are used largely in the dairies both in Hampshire and Dorsetshire, and parts of Sussex and Surrey. When Mr. Cardus occupied the farm of Town Hill, near Southampton, he took over with it a herd of Jersey cows which the late Mr. Duff had imported and bred from. To these he used imported bulls, and also introduced some of the English stock, using a bull called "Dairy King," bred on both sides from Mr. Gilbey's herd; he has successfully exhibited his animals, and he keeps them in houses opening into large straw-yards, exactly in the same manner as the ordinary cattle of the county are kept. His

system is to let his cows go out to graze all the year round, but to bring them in at night, except in the height of summer. In the spring and autumn, after the evening milking from 4 to 5 o'clock, they go out until dusk. When they come in they get barley or oat-straw, a little cake, sometimes linseed or cotton-cake mixed, occasionally cotton-cake alone, and a little hay. The calf, as a rule, is taken away from the cow as soon as it is born. In the case of a heifer with her first calf the calf sucks from a fortnight to six weeks, in order to develop the teats and udder. When taken from the cow the calf receives new milk for two to three months; then for a short time it has half new and half skim-milk, and finally receives skim-milk alone until six months old. Pulped roots, swedes generally, with a little barley-meal and bran, with a handful of hay at night, form the food of the heifers until they go to the bull, from 12 to 15 months old, according to their size and growth. The heifers are turned out to graze daily in all weathers, and come into an open shed, with barley-straw at night. Mr. Cardus adopts a useful plan of building a large rick of barley-straw in the middle of the straw-yards, and in the depth of winter the animals seem to prefer lying about under the rick instead of going into the covered sheds. He has lately grown carrots and pulped them with swedes, giving bran, and no barley-meal, and the animals have thriven well upon it. Cabbage, too, is given with good effect to the cows. Weakly calves get a little more and varied food and new milk longer. The bulls are kept tied, and only in moderate condition. No measurement is taken of the yield of milk or butter. One cow, however, showing an extraordinary udder, was tested two months after calving, when $13\frac{1}{4}$ lbs. of butter was obtained from one week's cream. One peculiarity at Town Hill has been observed in the horns of the animals: those of the female invariably come small, delicate, and are gracefully curled, but those of the males are very much stronger and coarser, even when the animals are closely related, indeed own brothers and sisters. This is attributed to the good constitution of the cattle and their aptitude to feed. Animals not breeding or milking well, or showing defective udders, are prepared for the butcher, and many of the cows go off fat at 20*l.* in Southampton market.

Mr. Fisk, at Brighstone, in the Isle of Wight, has a good and well-managed herd. To imported cows he uses mostly bulls bred in England, and he finds the Jerseys quite as hardy as cross-breds. The calf is allowed to remain on the dam about a week, according to its strength; it is weaned on new milk for a month; afterwards has warmed skim-milk with beans or peas and hay until it is four months old. The milk is

then reduced and sliced mangolds substituted, and, if the season is good, the calves are turned out to grass, with a shed to run in, getting a little cake or corn. At eight months old they keep themselves on pasture, but, if late calves, and the weather is severe, they are housed at night and fed with roots and hay. As yearlings they are wintered in an open yard with a shed, getting a few roots or cake and hay. If the hay crop be short, straw is substituted with a little extra cake, meal, or roots. The meal is mixed usually with chaff. The bull is turned in with them when they are about fifteen months old. Mr. Fisk attributes much of his success to the manner in which he manages his cows. The cow calves in a loose box, and receives a bran-mash twice a day and lukewarm water, and on the third day is allowed, if the weather is fine, to go into a sheltered yard for a few hours in the middle of the day. On the seventh or eighth day she is put into the cow-house, and fed on meal and chaff or cake with hay. The meal is usually a mixture of barley, pea, and maize, of which about 10 lbs. is given in winter and 6 lbs. in summer. Every day the cows go out in a sheltered yard, and if the weather is fine on a dry pasture. In warm weather they lie out at night, but the meal or cake is still continued until the cow is let dry, which is generally six weeks before calving. During these six weeks she is allowed to run into a sheltered yard, with rough hay or a little barley or oat-straw. Mangolds are never given until late in the spring, and it is found that they increase the flow of milk, but do not increase the yield of butter. Under this system Mr. Fisk has never lost a cow from milk-fever. The yield of butter is considered to depend not only upon how the cow is kept at any one time, but upon the general management. The greatest return from 15 cows was 10 lbs. each weekly for several weeks; the heifers made 6 lbs. The milk is allowed to remain, according to the weather, from 24 to 36 hours. The cream is then taken and churned twice a-week. Compared with that from other animals, the cream requires less working. Owing to the closeness of the texture of the butter, there is a very small quantity of whey, and the butter keeps firmer in hot weather and sweeter longer than that made from other cows under the same system.

Having thus attempted to describe the breed and its management in this country, let us turn again to Jersey, whose rugged cliffs and pretty bays lend such a charm in fine weather to the scenery as the vessel glides into the beautiful harbour at St. Heliers. The neat tidy gardens, the fruit-trees, the prim clean houses, and capital new cow-stables, all betoken the industry and prosperity of the inhabitants; whilst the narrow shady lanes, the orchards, the hedgerows, and the sweet balmy

air, remind one of Devonshire. Nothing strikes the stranger sooner than the pretty short-legged, dark-faced, long-tailed cows grazing with a rope tied round their horns and fastened about half a dozen yards off to a peg driven into the ground. This is the tethering system for which the Island is so famous. It doubtless originally arose from the small size of the farms, some of the largest being only about 20 acres in extent. Every piece of available land is cultivated, and banks divide the little fields, in which may be frequently seen strips of corn, parsnips, carrots, potatoes, and cabbages growing side by side, as well as clover and rye-grass. The orchard is generally close by, and there the cows are usually tethered in rows of five or six, according to the size of the orchard and number of stock, for rarely are more than eight or ten cows kept on a farm. So clean and close is the rich grass eaten that it has the appearance of being roughly mown, and as a patch is eaten the cows are shifted on a few yards four or five times a day. Liquid manure is applied to the grazed portions, so that by the time the cows have reached the bottom of the field, the grass at the top is ready for them to be tethered on again, so quick and luxuriant is the growth. Of its economy there can be no question, as the grass is not trampled, and good and bad are alike eaten. The animal, too, remains docile, and two of them can easily be led by a young girl; women usually tend and milk the cows and feed the calves. This docility is early acquired, for the calves are very soon tied with halters and led. Bull calves for veal are sometimes allowed to suck, but generally the calves are fed by hand from the day of their birth with new milk for a fortnight. The heifer calves then get sour or skimmed milk thrice a day. On some farms for the first month the dam's milk is given diluted with boiling water. At the end of two or three weeks they will receive sour milk with bran; when able to eat, in about six weeks, they get hay with pulped roots and chaff, and a little meal. Grass is cut and laid before them in spring and summer; the skimmed milk is gradually reduced, and by some breeders is superseded by steeped linseed, until, at five or six months old, they are allowed to run out, and on the small occupations tethered. In Guernsey buttermilk and hay-tea are given with good effect to calves up to six or seven months old. Many breeders do not serve their best heifers until they are eighteen months old, but if any are well grown they are put-to earlier. The greatest care is bestowed on the cow before and at calving. She is treated most kindly, and carefully dried from four to six weeks before calving, which usually takes place in January, February, or March. She is fed moderately with straw and a little hay, and bran-mashes, barley-meal, or linseed are given to keep

the bowels loose. Many years ago the cows were kept exceedingly thin and low; indeed, so weakly did they become, that it was necessary sometimes to help the older cows to rise. After the introduction of roots, a better system of farming took place, under the auspices of the Agricultural Society; the cows were better fed, and, to the surprise of the Islanders, some of them fell with milk-fever. Now, roots are seldom, if ever, given before calving; the cow is kept moderately; it is a rare thing to hear of one dropping. Immediately after calving bran and warm water are given; the old system of "toast and cider," warm and often with a little powdered ginger in it, is still practised, especially if the cow is a little queer or has had a hard time. Bran-mashes or barley-meal, with plenty of lukewarm water, is given for a few days; by some breeders it is continued for a month, and the cow is milked three times daily for two or three months. Parsnips, mangolds, or swedes, hay or straw, and the customary food, according to the season, follow. From May till October the cows are tethered, and remain out at night. In very hot weather they are taken in or sheltered from the heat and flies during the middle of the day. In the autumn, when the grass becomes short, the leaves of parsnips and mangolds, and occasionally of cabbage, are given, and begin to help out the winter food. Every day the cows are allowed to go out for two or three hours' run, except in very stormy weather or winter. Gentleness, quietude, and warmth increase both the flow of milk and the yield of butter. Milking takes place generally between 5 and 6 in the morning in winter, when parsnips, carrots, or mangolds are given; then hay and a few more roots, before they go out, about 10 or 11 o'clock. Hay is placed before them on their return about 4 o'clock, and roots again at milking time, with a bundle of straw at night. The quantity of milk given varies; it is not so great as is the large yield of butter from it. Richness—or the deep orange colour of the ears, teats, and hide generally—is now looked upon as one of the highest points and the great aim in breeding. Although some cows will give upwards of 20 quarts a day, it is apt to be thin, and 8 to 12 quarts is a fair standard. This will yield usually 7 to 10 lbs. of butter weekly, but 5 to 6 lbs. per week throughout the year is a good average from one cow.

The bull is highly fed; this is the rule—if kept in the house he is fed with hay, roots and meal, but if tethered in summer he lives as the cows. He is, however, always seen in good condition, and rarely kept over two years old, for keeping them well gives them, it is considered, a handsome appearance, and they are ready, and worth more to the butcher should they prove at all troublesome.

It is estimated that Jersey, in size some eleven miles long by five and a-half wide, containing about 39,000 acres, a little more than half of which is cultivated, has, according to the latest Agricultural Returns, 2261 horses, 10,922 head of cattle, 346 sheep, and 5844 pigs. Of the cattle, about 2000 are exported annually to England and America; only a few go to other countries. The population is estimated at 60,000; about half live in St. Heliers; so that, in addition to all other live stock, the island has one cow on each two acres. In England, this extent of clear land is held to be necessary for a cow's support. Seeing the number of buildings, of roads, of hedgerows on the Island, the acreage actually employed therein must be considerably under two acres for every single head. No animal in its yield of milk and butter can compare, for its size, with the Jersey cow; and the increase of the breed of late years in this country, and the extraordinary number exhibited at the Kilburn Show, have been the surprise of many a farmer. For years this has been "the parson's cow." It may not bear comparison with the Shorthorn; its angular appearance may call forth derision; still the neglect of the dairy properties in our indigenous breeds may have had some influence in spreading the Jersey. The high price of good butter and a difficulty of obtaining pure rich milk have led to many a Jersey cow being kept in the neighbourhood of large cities. Her gentleness, her small stature, her quietness, her adaptability to any circumstances, as well as her really large produce when generously fed, all combine to make her a most valuable assistant. The taste for country life and for occupying a bit of land is inherent in most Englishmen, and with that comes the love of animals. As wealth and population increase, large estates around cities are yearly broken up for villas with a few acres of grass and garden. There the Jersey finds a home, and makes a bountiful return for the food supplied her. There she already flourishes: and in time she will doubtless creep into small farms; for her great dairy profit and her capability of being kept and fed in a confined space are great recommendations to the little dairy farmer. The steady increase of the American beef supply is likely to have an important influence on our larger breeds; but fresh milk, from the days of Abraham downwards, has ever been man's first and natural food, and this seems to be produced at home. Treated generously and kindly, kept warm and healthy, the Jersey cow will supply with nature's richest food and exert a kindly influence on our multiplying thousands.

XVII.—*On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted.* Parts I. and II.

By J. B. Lawes, LL.D., F.R.S., F.C.S., J. H. Gilbert, Ph.D., F.R.S., F.C.S., and R. Warington, F.C.S.

CONTENTS:

Introduction.

It is proposed to collect together in the present paper the results of all the investigations relating to the Rain and Drainage-waters of Rothamsted. A part of these investigations has been already published—as the determinations of Ammonia in Rain, communicated to the British Association in 1854; the determinations of Ammonia and Nitric Acid in Rain by Prof. Way, published in this 'Journal' in 1857; the numerous analyses of the Rain and Drainage-waters by Dr. Frankland, published in the Sixth Report of the Rivers' Pollution Commission, 1874; and the analyses of the Drainage-waters published by Dr. Voelcker in this 'Journal' in 1874. Some of these results are inaccessible to most readers; many of them we have never yet had an opportunity of discussing fully.† Having therefore a considerable amount of new matter to bring forward, it has seemed best to treat the subject as a whole, and to discuss as concisely as possible the relation of all the facts hitherto ascertained, bringing the record down to the present time.

The subject will divide itself into Four Parts. The First Part will treat of the amount and composition of the Rainfall. The Second Part will embrace the results relating to Drainage

* Section 2 is not completed in the present paper for want of space, and Section 3 is for the same reason postponed; it is hoped that the matter now omitted will appear in the next number of this 'Journal.'

† Some of the bearings of these earlier investigations have been already pointed out in Rothamsted Reports, which have appeared in this 'Journal.' See papers on the 'Effects of the Drought of 1870 on some of the Experimental Crops at Rothamsted,' 1871; 'Report of Experiments on the Growth of Barley for Twenty Years in succession on the same Land,' 1873, pp. 367–372; 'Our Climate and our Wheat Crops,' 1880, pp. 199–210.

and Evaporation from uncropped land. The THIRD PART will deal with the Drainage-waters from land cropped and manured. In the FOURTH PART we shall endeavour to apply some of the facts previously given to the elucidation of certain agricultural problems. In each section of the subject we hope to find space for a brief glance at some of the results obtained by others in the same field of inquiry.

PART I.—THE AMOUNT AND COMPOSITION OF THE RAINFALL.

1. *The Rain-gauges.*—With the purpose of determining accurately the amount of the rainfall, and at the same time of collecting rain in sufficient quantity to allow of its chemical analysis, a large Rain-gauge was erected during the winter of 1852–3 in one of the arable fields on the farm at Rothamsted. The collecting funnel was of wood lined with lead. Its form was rectangular; the length 7 feet 3·12 inches, the width 6 feet. It had therefore an area of $\frac{1}{1000}$ of an acre. The surface of the funnel was 2 feet above the level of the surrounding ground, and 420 feet above the level of the sea.

The water collected in this funnel was received by a glass carboy standing beneath it. This carboy when nearly full overflowed through a pipe in the neck into a second carboy in connection with it. The quantity of water collected was, when necessary, ascertained twice a day by weighing the carboys. One inch of rain falling on this gauge would furnish 226¼ lbs. of water.

This gauge was in constant use from February 1853 to November 1876. Latterly, that is since August 1873, the use of carboys was discontinued, the water being received in galvanised iron cylinders fitted with gauge-tubes, and its quantity determined by measurement instead of by weight.

The large gauge just described has now been replaced by another of identical form and area, erected in the immediate neighbourhood of the old gauge. The land on three sides of the new gauge is not now under tillage, having been laid down in grass in 1874. On the remaining side is a field continuously cropped with roots. The edge of the collecting funnel of the new gauge is constructed of plate-glass, the remainder of the gauge being, as before, of lead. The edge of the funnel is about 1 foot above the level of the surrounding soil.

The water from the new gauge is received in a galvanised iron cylinder placed beneath; this when nearly full overflows into a similar cylinder standing at its side, which in its turn overflows into a third, and that into a fourth. Each cylinder will contain rather more than half an inch of rainfall, and is provided with a graduated gauge-tube by means of which the

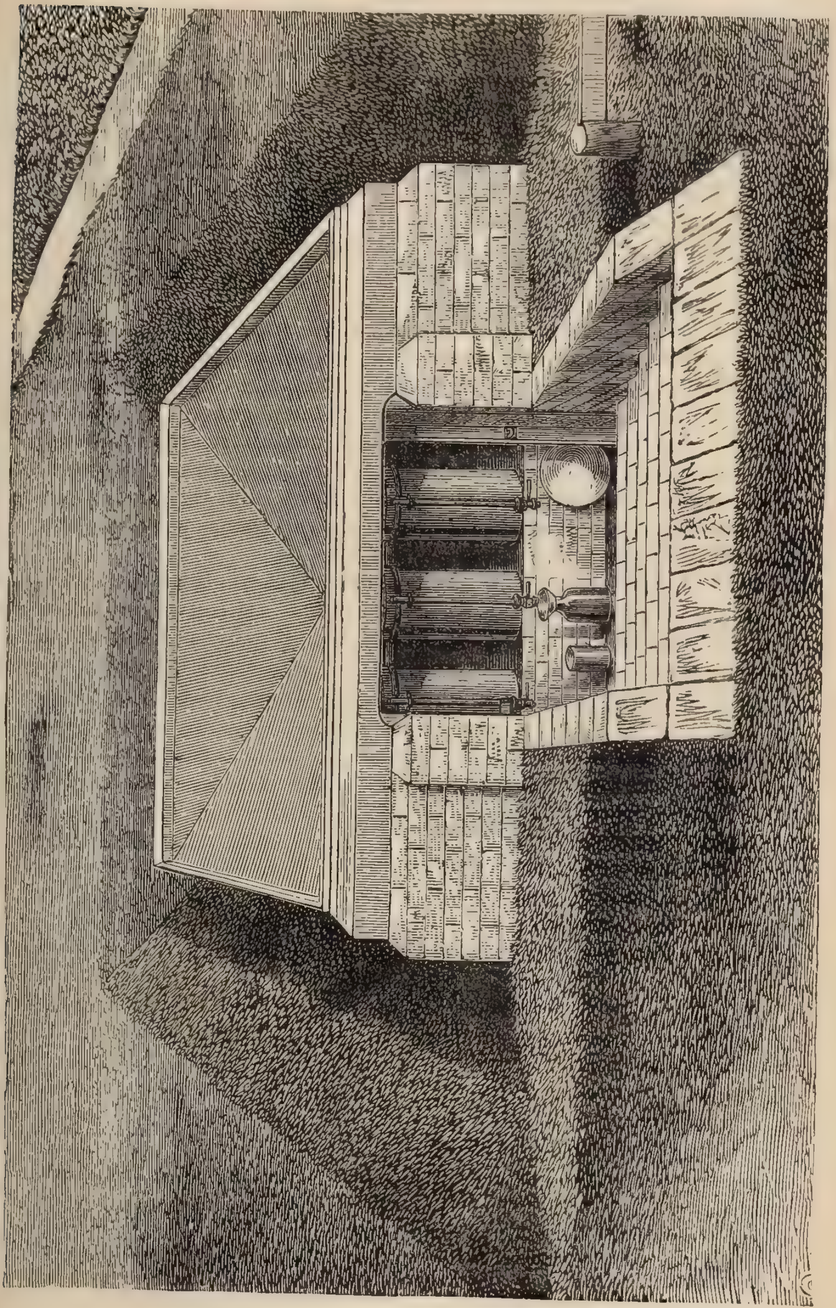


Fig. 1.—*Large Rain-gauge and its Collectors.*

rainfall can be ascertained to $\frac{1}{1000}$ of an inch. A sketch of this rain-gauge will be found in Fig. 1 (p. 243). Its use commenced in July 1873, and has been continued down to the present time.

Besides the two large gauges just described, an ordinary rain-gauge, consisting of a circular copper funnel 5 inches in diameter, delivering into a bottle enclosed in a metal cylinder, has been continuously employed, and its readings recorded. This gauge was at first placed by the side of the first large gauge, and at the same elevation above the ground; it has since been moved to the side of the second large gauge, and brought to its level.

2. *The Amount of the Rainfall.*—The total rainfall recorded by the first and second large gauges during the first year of their comparison was practically identical, the old gauge showing a rainfall of 22·361 inches, and the new gauge a rainfall of 22·363 inches. A considerable difference afterwards appeared between them, arising apparently from leakage in the old gauge, which had also altered somewhat in form from the warping of the wooden framework. The use of the old gauge was therefore finally discontinued.

The small gauge has shown, on an average, a distinctly smaller rainfall than the large gauges. Taking a mean of 28 years (1853–80), the large and small gauges compare as follows:—

TABLE I.—COMPARISON of the LARGE and SMALL RAIN GAUGES (MEAN of 28 YEARS).

	Mean Monthly Rainfall.		Deficiency of Small Gauge.	
	Large gauges.	Small gauge.	Actual.	Per cent.
	Inches.	Inches.	Inches.	Inches.
January	2·590	2·263	0·327	12·6
February	1·728	1·508	0·220	12·7
March	1·693	1·399	0·294	17·4
April	2·008	1·803	0·205	10·2
May	2·329	2·149	0·180	7·7
June	2·451	2·272	0·179	7·3
July	2·704	2·533	0·171	6·3
August	2·643	2·440	0·203	7·7
September	2·638	2·403	0·235	8·9
October	3·089	2·784	0·305	9·9
November	2·345	2·113	0·232	9·9
December	2·084	1·861	0·223	10·7
Total for Year ..	28·302	25·528	2·774	9·8

It is seen that the small gauge agrees best with the large gauges in the summer months, and that on either side of July the difference between them gradually increases. The largest

difference occurs in March, but in all the winter months the variation is considerable. On the whole year the small gauge shows, on an average, 2·774 inches less rain than the large gauges, or a deficiency of 9·8 per cent.

Some of the causes contributing to this difference between the gauges are tolerably manifest. Thus a heavy snow-fall is much better retained by the large gauge than by the small; the deposits of mist, dew, and hoar-frost are also distinctly greater with the large gauge. The increased difference between the gauges during the winter months thus admits of explanation, while the difference observed during the middle of summer is not so easily accounted for.

The rainfall at Rothamsted for each month and year during the twenty-eight years 1853–80 is given in Table II. The rainfall for January 1853 is adopted from the records at Chiswick, the Rothamsted gauge being not then completed. From February 1853 to the end of June 1873 the results given are those obtained with the first large gauge. From this date to the end of 1874 the results are the mean of those yielded by the first and second large gauge. After this date the rainfall is that measured by the second large gauge. For certain days on which a portion of the rainfall was lost the readings of the small gauge have been adopted. For two months, distinguished by brackets in the Table, an estimate has been made of the probable rain or snow on certain days, no certain record being obtained.

The average rainfall at Rothamsted during twenty-eight years has been 28·302 inches. This rainfall is distinctly higher than that usual in the eastern counties of England. In the excellent Hyetographical Map, prepared by Mr. G. J. Symons for the Sixth Report of the Rivers' Pollution Commission, it appears that while the rainfall of the eastern counties is generally below 25 inches, the rainfall of an isolated district comprising part of Hertfordshire, Buckinghamshire, and a small portion of Bedfordshire, is between 25 and 30 inches. It is in this district of relatively high rainfall that Rothamsted is situated.

We have been kindly supplied with copies of the records of rainfall at various stations, situated mostly in the neighbourhood of Rothamsted, those stations being selected at which observations had been made throughout the twenty-seven years, 1853–79. We are indebted to the Rev. C. W. Harvey for copies of the records at Gorhambury, St. Albans; Nash Mills, Hemel Hempstead; and Hitchin: to Mr. J. M'Laren for the record of his own observations at Cardington, Bedford; and to Mr. G. J. Symons for copies of the records at Royston, and at Stretham, Ely. To compare with these we have also taken the records of

TABLE II.—MONTHLY and YEARLY RAINFALL at ROTHAMSTED during 28 YEARS, 1853 to 1880 (Large Gauges).

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total 12 Months.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1853	2·020	1·309	2·363	2·999	1·682	3·395	4·484	2·978	2·011	3·659	2·052	0·408	29·360
1854	2·034	0·919	0·514	0·498	4·384	0·763	1·051	2·824	0·779	2·289	1·531	1·760	19·376
1855	0·598	0·993	2·364	0·410	2·324	1·647	6·956	2·633	1·545	5·501	2·473	1·722	29·166
1856	2·782	1·352	1·004	2·611	4·707	1·912	1·484	2·645	2·187	2·874	1·422	2·235	27·215
1857	3·708	0·570	1·484	2·164	1·105	2·215	1·611	3·077	4·172	5·910	2·247	0 579	28·842
1858	0·970	1·429	0·801	2·583	2·553	0·958	3·186	1·561	1·537	1·600	0·876	1·986	20·040
1859	1·339	2·014	1·729	2·704	2·132	3·409	3·021	2·778	3·436	2·861	2·284	2·792	30·499
1860	3·425	1·221	2·026	1·941	4·302	6·256	2·033	4·223	2·768	1·767	2·455	1·430	33·847
1861	0·813	2·415	2·286	1·276	1·045	2·976	3·190	0·887	1·633	1·463	3·993	1·578	23·555
1862	1·773	0·599	3·061	2·838	2·914	3·407	1·798	2·504	2·289	4·052	1·345	1·736	28·316
1863	4·037	0·744	0·913	0·960	1·011	4·604	0·703	2·866	2 907	2·349	2·217	1·639	24·950
1864	1·283	0·771	2·475	1·248	1·880	1·786	0·894	0·775	3·136	1·292	2·472	0·546	18·558
1865	4·006	1·839	1·423	0·468	3·048	0·684	2·934	5·171	0·169	7·355	2·662	1·461	31·220
1866	3·971	3·238	1·655	1·950	1·244	4·510	3·011	3·441	4·104	1·818	2·162	2·703	33·807
1867	2·564	1·938	2·171	2·822	3·350	1·062	4·103	2·155	2·060	1·856	0·320	2·041	26·442
1868	3·933	1·494	1·922	2·187	0·732	0·369	0·369	3·771	2·799	2·038	0·422	4·553	24·589
1869	3·435	2·410	1·476	2·129	3·226	1·065	0·971	1·351	2·788	2·049	2·383	3·198	26·481
1870	1·809	2·100	1·796	0·456	1·347	0·975	1·118	1·587	2·305	4·134	1·398	2·649	21·674
1871	1·454	1·630	1·503	2·882	0 964	3·864	3·996	0·770	4·073	1·786	0·659	1·419	25·000
1872	4·679	1·472	2·150	1·626	2·891	3 091	2·892	2·285	1·362	4·673	3·871	4·036	35·028
1873	4·019	1·342	2·046	0·631	1·657	1·746	2 534	2·689	2·376	2·826	1·990	0·713	24·569
1874	1·932	1·727	0·652	2 141	1·187	1·593	2·810	1·748	3·618	3 225	2·345	1·800	24·778
1875	3·993	1·176	0·868	1·558	2·736	3·528	5·660	1·102	2·800	5·898	4·432	1·189	34·940
1876	1·808	3·054	2·899	[3·333]	0·782	1·350	1·463	2·975	5·019	1 519	4·204	6·003	34·409
1877	4 990	2·098	2·550	2·762	2·824	1·435	3·284	2·596	1·529	1 950	5·159	2·279	33·456
1878	1·750	1·804	0 977	4·093	4·976	2·505	0·656	4·976	1·462	2·987	4·545	1·601	32·332
1879	2·849	3·799	1·183	2·790	3·481	5·551	4·244	[6·558]	3·131	0·815	0·814	0·823	36·038
1880	0·550	2·901	1·128	2·161	0·742	1·966	5·261	1·069	5·858	5·939	2·919	3·472	33·966
Average 28 years	2·590	1·728	1·693	2·008	2·329	2·451	2·704	2·643	2·638	3·089	2·315	2·084	28·302

Greenwich rainfall, as given by Mr. W. C. Nash in Symons' 'British Rainfall, 1879.' In the following Table these rainfall-records are compared with the results shown by the large gauge at Rothamsted * :—

Table III.—The Average Monthly and Annual Rainfall observed at Eight Stations during 27 Years, 1853–79.

	Within High Rainfall district.			Without High Rainfall district.				
	Rothamsted, Herts.	St. Albans, Herts.	Hemel Hempstead, Herts.	Hitchin, Herts.	Royston, Herts.	Cardington, Beds.	Stretham, Ely, Camb.	Greenwich, Kent.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January ..	2·67	2·69	2·61	2 15	2·07	1·83	1·42	2·18
February ..	1·69	1·67	1·66	1·50	1·49	1·30	1·03	1·37
March ..	1·71	1·81	1·74	1·50	1·52	1·33	1·20	1·47
April ..	2·00	1·91	1·86	1·70	1·59	1·51	1·38	1·68
May	2·39	2·36	2·26	2·08	2·04	1·85	1·79	2·16
June	2·47	2·37	2·35	2·06	1·91	2·06	1·97	2·16
July	2·61	2·52	2·44	2·52	2·14	2·19	2·49	2·38
August ..	2·70	2·63	2·53	2·49	2·41	2·37	2·41	2·43
September .	2·52	2·54	2·53	2·23	2·19	2·09	2·05	2·27
October ..	2·98	2·84	2·76	2 51	2·31	2·17	2·00	2·67
November ..	2·32	2·32	2·24	2·13	2·07	1·82	1·87	2·03
December ..	2·03	2·13	2·08	1·79	1·78	1·53	1·33	1·87
	28·09	27·79	27·06	24·66	23·52	22·05	20·94	24·67

The smallest fall of rain occurs in all cases in February and March; from this point there is at Rothamsted a steady increase up to July and August; there is then a slight decrease in September, and the maximum rainfall of the year is reached in October: after this there is a rapid fall to December, followed by a considerable rise in January. The records at St. Albans and Hemel Hempstead agree excellently with those at Rothamsted, the latter station having, however, a somewhat greater summer rainfall.

With Hitchin, Royston, Cardington, and Stretham, which

* The records of the large gauge at Rothamsted do not compare exactly with those of the smaller gauges of other stations; while, however, the records of the large gauge are comparatively rather high, those of our 5-inch funnel gauge are in the other direction. The excess of the large gauge over ordinary gauges is probably about 1 inch per annum. The rain-gauges employed at the various stations named are as under:—

			Height above ground.	Height above sea.
Rothamsted, size of gauges ..		87 × 72 in.	.... 1 and 2 ft.	.... 420 ft.
St. Albans, diameter of gauge		6 in.	.... 2 ft. 0 in.	.... — ,,
Hemel Hempstead	,,	12 ,,	.... 3 ,, 9 ,,	.... 237 ,,
Hitchin	,,	8 ,,	.... 1 ,, 6 ,,	.... 238 ,,
Royston	,,	8 ,,	.... 0 ,, 6 ,,	.... 269 ,,
Cardington	,,	12 ,,	.... 3 ,, 0 ,,	.... 109 ,,
Stretham, Ely	,,	9 ,,	.... 4 ,, 9 ,,	.... — ,,
Greenwich	,,	8 ,,	.... 0 ,, 5 ,,	.... 155 ,,

lie in a different rainfall district, the maximum rainfall occurs in August or July, not in October. At Greenwich, however, the order of the rainfall agrees with that observed at Rothamsted, St. Albans, and Hemel Hempstead. The rainfall in both districts is very similar in the month of August; they differ most in January.

According to the rule adopted by many engineers, the driest year in a long series will have a rainfall one-third less, and the three consecutive driest years an average rainfall one-sixth less than the mean; while the rainfall in the wettest year will be one-third greater than the mean. The maximum rainfall is thus reckoned as twice as great as the minimum. The extreme rainfalls recorded at the eight stations just mentioned occurred as follows:—

	Wettest Year.	Driest Year.	Driest Three Years.
Rothamsted	1879	1864	1862–64
St. Albans	1872	1864	1854–56
Hemel Hempstead ..	1872	1864	1862–64
Hitchin	1860	1854, 1864	1862–64
Royston	1879	1864	1862–64
Cardington	1875	1870	1869–71
Stretham, Ely	1877	1854	1854–56
Greenwich	1860	1864	1856–58

The rainfalls recorded at these extreme periods of excessive rain or drought compare as follows with the quantities which would be calculated on the above mode of reckoning:—

TABLE IV.—The RAINFALLS recorded in the WETTEST, DRIEST, and DRIEST THREE CONSECUTIVE YEARS during 27 YEARS, 1853–79, compared with the calculated ESTIMATE.

	Wettest Year.		Driest Year.		Driest Three Consecutive Years.	
	Record.	Estimate.	Record.	Estimate.	Record.	Estimate.
Rothamsted	36·04	37·46	18·56	18·73	23·94	23·41
St. Albans	38·15	37·05	18·66	18·53	23·68	23·16
Hemel Hempstead ..	36·28	36·08	16·96	18·04	22·25	22·55
Hitchin	30·28	32·88	17·16	16·44	19·68	20·55
Royston	30·06	31·36	16·67	15·68	19·49	19·60
Cardington	31·39	29·40	14·87	14·70	18·30	18·37
Stretham, Ely	29·03	27·92	13·81	13·96	15·87	17·45
Greenwich	31·90	32·89	16·38	16·45	20·71	20·56
Mean	32·89	33·13	16·63	16·57	20·49	20·71

The agreement between the amounts of rain actually recorded and those calculated by the practical rules above referred to is throughout very fair, and amply justifies their application to purposes of water-supply.

3. *The Composition of the Rain-water.*—When the vapour of water is condensed in the upper regions of the atmosphere, and descends in the form of rain, hail, or snow, it reaches the earth holding in solution more or less of the gases present in the atmosphere. The quantity of any gas dissolved by rain will depend on the solubility of that gas in water, will be greater in proportion to the abundance of that gas in the atmosphere, and will also be greater, other circumstances being equal, as the temperature of the rain is lower, and the pressure of the atmosphere higher. In rain-water collected in the country nitrogen and oxygen will be the gases chiefly present, with a small quantity of carbonic acid, and a still smaller amount of carbonate of ammonium.

Besides the gases which rain holds in solution, it contains various solid substances gathered from the atmosphere during its descent. Some of these, as the chlorides, sulphates, and nitrates of sodium, calcium, and ammonium, are dissolved by the rain; others, as particles of dust and soot, are merely mechanically held, and give to rain-water its ordinary dirty appearance. Most of the constituents of rain-water are present in very minute quantity, and the powers of chemical analysis are taxed to the utmost to determine them.

It will be well to notice as briefly as possible the sources of the more important matters dissolved by rain-water in its passage through the air.

The ammonia of the atmosphere is derived from the decay of animal and vegetable matter, both on land and in the ocean, and from the combustion of fuel, especially coal; the air of towns is much richer in ammonia than that of the country. According to M. Schloesing, the ocean of the tropical regions is the most important source of atmospheric ammonia. At the high temperature of tropical latitudes, the ammonia produced by the decay of organic matter diffuses freely into the atmosphere, and is carried by winds to all parts of the globe. In northern latitudes southerly winds are those richest in ammonia.

The nitric acid present in the atmosphere is due in part to electrical agency. Discharges of electricity in the air determine the combination of the nitrogen and oxygen of which the atmosphere is composed, nitrous acid being formed; ozone is at the same time produced, which is capable of oxidizing both nitrous acid and ammonia, nitric acid in each case resulting. A source of nitric acid independent of electrical discharge,

exists in the oxidation of ammonia by ozone and peroxide of hydrogen. As the latter substance is evolved when turpentine, and possibly other bodies, are oxidised in the air, the neighbourhood of a pine-forest should be favourable to the formation of nitric acid in the atmosphere.

The sulphates of the atmosphere are, according to Angus Smith, chiefly derived from the oxidation of the sulphur compounds evolved during the decay of animal matter. In towns the sulphates are much increased by the oxidation of the sulphurous acid contained in coal-smoke.

Chlorides are principally furnished by the sea, fine spray of salt-water being carried long distances by high winds. To a small extent chlorides may also be furnished by the combustion of fuel.

The quantity of ammonia and nitric acid contained in rain-water is a question of considerable interest to the agriculturist. As ammonia and nitric acid form the chief if not the only sources of the nitrogen of plants, and manures containing them are purchased by the farmer only at considerable expense, it becomes of great interest to ascertain the amount naturally supplied to our fields by rain.

De Saússure, Brandes, and Liebig had called attention to the existence of ammonia and nitric acid in rain-water before the commencement of the Rothamsted experiments. Some initiative determinations of the ammonia in rain were made at Rothamsted as early as 1846. Barral, in 1851, made determinations of both the nitric acid and the ammonia in the rain which fell in Paris during several consecutive months; and in 1852 Boussingault determined the ammonia in the rain collected at Liebfrauenberg, in Alsace. The opportunity afforded by the erection of the large gauge at Rothamsted of collecting considerable quantities of rain-water at a distance from any large town* was at once turned to account to follow up the subject. A fixed proportion of the day's rainfall was regularly set aside, and these quantities being mixed at the end of the month, a sample was obtained accurately representing the month's rainfall. Determinations of ammonia were made in these monthly samples for 15 months during 1853 and 1854. The method employed consisted in fractional distillation of the water, and determination of the ammonia in the distillate with a very dilute standard acid and alkali. The results of these analyses were communicated to the British Association for the Advance-

---

* Rothamsted lies about 25 miles north-west of London, and about four miles north of St. Albans. The village of Harpenden, with a very scattered population of nearly 3000, lies mostly to the north-east and east of the rain-gauge, a majority of the houses being probably about three-quarters of a mile distant.

ment of Science in 1854, and to the Report of the Association for that year we must refer for all details of this investigation.* A summary of the results will be found in Table V.

TABLE V.—NITROGEN existing as AMMONIA in RAIN WATER collected at ROTHAMSTED 1853–4.

	1853.			1854.		
	Rainfall.	Nitrogen as Ammonia.		Rainfall.	Nitrogen as Ammonia.	
	Inches.	Per Million of Rain.	Per Acre. lbs.	Inches.	Per Million of Rain.	Per Acre. lbs.
January	..	..	..	2·034	0·64	0·30
February	..	..	..	0·949	0·78	0·17
March	2·363	1·19	0·63	0·514	0·78	0·09
April	2·999	0·67	0·46	0·498	0·80	0·09
May	1·682	1·10	0·42	4·384	0·37	0·38
June	3·395	1·05	0·80	..	..	..
July	4·484	0·77	0·78	..	..	..
August	2·978	0·69	0·46	..	..	..
September ..	2·011	0·61	0·28	..	..	..
October	3·659	0·57	0·47	..	..	..
November ..	2·052	0·66	0·31	..	..	..
December ..	0·408	1·33	0·12	..	..	..

We have here during the first 12 months a total rainfall of 29·014 inches, containing nitrogen in the form of ammonia equal to 5·20 lbs. per acre. In the whole 15 months over which the determinations range we have a rainfall of 34·41 inches, containing on an average 0·74 of nitrogen, as ammonia, per million of water.†

An attempt was made to determine the small amount of nitrogen existing as nitric acid in some of the above rain-waters, but the methods then known did not prove sufficiently accurate for the purpose.

The rain collected at Rothamsted during 1855 and 1856 was analysed by Professor J. T. Way; he determined the quantity both of ammonia and nitric acid in mixed samples of water representing the rainfall of each month. The ammonia in the rain was determined by a method similar in principle to that

* "On the Amounts of, and Methods of estimating Ammonia and Nitric Acid in Rain Water." By J. B. Lawes and Dr. J. H. Gilbert. Report of British Association, 1854.

† This average is not the mean of the fifteen monthly proportions of nitrogen per million given in the table, which would amount to 0·80, but is arrived at by dividing the total lbs. of nitrogen per acre contained in the fifteen months' rain by the total lbs. of rain per acre which fell in that period; the figure thus arrived at truly represents the composition of the water, supposing the whole rainfall of the fifteen months had been mixed together. The same method will be employed in calculating general averages throughout this paper.

employed at Rothamsted. The nitric acid was determined by a new and delicate method devised for the purpose by Professor Way. The details of this investigation will be found in the Royal Agricultural Society's Journal, vol. xvii. 142, 618. A summary of the results is given in Table VI. The figures given by Way have been recalculated so as to compare with the other analyses in this Paper.

Table VI.—Nitrogen as Ammonia and Nitric Acid in Rain Water collected at Rothamsted in 1855 and 1856.

—	1855.			1856.		
	Rainfall Inches.	Nitrogen per Million.		Rainfall Inches.	Nitrogen per Million.	
		As Ammonia.	As Nitric Acid.		As Ammonia.	As Nitric Acid.
January	0·598	1·08	0·06	2·782	0·93	0·09
February	0·993	1·22	0·16	1·352	1·60	0·07
March	2·364	1·01	0·08	1·004	1·09	0·13
April	0·410	1·45	0·13	2·611	1·72	0·07
May	2·324	0·94	0·13	4·707	1·49	0·10
June	1·647	1·59	0·30	1·912	1·33	0·17
July	6·956	0·72	0·06	1·484	1·00	0·13
August	2·633	0·94	0·22	2·645	0·82	0·13
September	1·545	1·12	0·08	2·187	1·42	0·13
October	5·501	0·72	0·13	2·874	0·71	0·12
November	2·473	0·64	0·07	1·422	0·94	0·16
December	1·722	0·79	0·06	2·235	0·94	0·15
Whole Year ..	29·166	0·88	0·12	27·215	1·18	0·12

It appears that on the whole a somewhat larger amount of ammonia was found by Way than in the previous determinations at Rothamsted; this is especially the case in the analyses of rain-water collected in 1856. On the average of the whole 24 months Way found the proportion of nitrogen in the form of ammonia to be 1·03 per million of rain-water. The nitrogen existing as nitric acid is a far smaller quantity, averaging in the 24 months only 0·12 per million. Boussingault had found in rain-water collected on a wooded hillside at Liebfrauenberg, from May to November 1852, an average of 0·48 parts of nitrogen as ammonia per million of water. In rain collected at the same place at a similar time of year in 1856 and 1857, he found the nitrogen as nitric acid to average only 0·048 per million.

The results given in Tables V. and VI. show that the quantity of ammonia in rain-water is subject to very con-

siderable variation. This difference is partly due to a variation in the quantity of ammonia present in the atmosphere. Under natural conditions the air will be richest in ammonia in summer-time, and generally when a warm wind is blowing. In towns, however, where much ammonia is produced by the combustion of coal, the winter may be the period when ammonia is most abundant in the atmosphere. At Rothamsted the rain is apparently richest in ammonia in summer-time. If we take the determinations made during the first 12 months at Rothamsted, and the subsequent two years' analyses by Way, and separately arrange those relating to what for our purpose we may call summer and winter periods, we arrive at the following average results:

TABLE VII.—NITROGEN AS AMMONIA in the RAIN of SUMMER and WINTER PERIODS; AVERAGE of THREE YEARS.

	RAINFALL.	Nitrogen as Ammonia.	
	Inches.	Per Million of Rain.	Pounds per Acre.
Summer (April to September)	16·203	1·02	3·74
Winter (October to March)	12·262	0·85	2·36
Whole Year	28·465	0·95	6·10

The nitric acid shown by Way's analyses is also slightly greater in the summer period, the average of two years giving for the summer rain 0·122, and for the winter rain 0·109 of nitrogen per million.

Another condition which has a still greater influence on the proportion of ammonia in rain is the amount and distribution of the rainfall. A heavy rainfall descending in a short time will always be poorer in ammonia than the rain of light showers distributed over a considerable period, the former rain-water having come in contact with a relatively smaller volume of air than the latter. Moreover, in a storm, or a consecutive rainfall, the latter part of the rain passes through an atmosphere already well washed, while in light showers the atmosphere is more or less renewed between each rainfall. The influence of the quantity of the rain on the proportion of ammonia it contains will be plainly seen if we arrange the 39 monthly analyses of rain-water already given according to the amount of rainfall in each month, as is done in the following Table:

TABLE VIII.—NITROGEN as AMMONIA in MONTHLY RAINFALLS arranged according to the AMOUNT of FALL.

	Average Rainfall.	Nitrogen as Ammonia, per Million.
	inches.	
Rainfall below 1 inch (7 months)	0·624	1·06
Rainfall between 1 and 2 inches (9 months)	1·530	1·17
Rainfall between 2 and 3 inches (16 months).. ..	2·473	0·91
Rainfall above 3 inches (7 months)	4·727	0·82

The smallest rainfall does not here contain the largest proportion of ammonia, the maximum of ammonia occurring in the rainfall standing second in the Table, but on the whole the proportion of the ammonia plainly falls as the amount of rain increases.

The nitrogen existing as nitric acid follows a similar order. The rain of three months in which the fall was below one inch, contained as an average 0·12 of nitrogen as nitric acid per million. The average of eight months, with a fall between one and two inches, was 0·14 of nitrogen per million. Ten months, with a fall between two and three inches, gave an average of 0·12 of nitrogen per million; while three months, with a fall exceeding three inches, gave 0·10 of nitrogen per million.

It appears that the smallest rainfall was not quite the richest either in ammonia or nitric acid. It may of course happen that a small monthly rainfall may not be a distributed one, but fall in a few heavy showers. A more general explanation appears to be that the conditions most favourable to a high proportion of ammonia in the rain-water (as a sudden change from a warm to a cold wind) are conditions generally attended by a somewhat considerable rainfall.

The determinations of ammonia made in three years' rainfall, and the determinations of nitric acid in two years' rainfall, lead to the following conclusions as to the quantity of nitrogen in these forms annually supplied to the soil by rain.

TABLE IX.—NITROGEN as AMMONIA and NITRIC ACID in the RAINFALL of THREE YEARS, in lbs. PER ACRE.

Years.	Rainfall.	Nitrogen per Acre, as Ammonia.	Nitric Acid.	Total Nitrogen.
	inches.	lbs.	lbs.	lbs.
1853–4	29·014	5·20	[0·74]	5·94
1855	29·166	5·82	0·72	6·58*
1856	27·215	7·28	0·76	8·00*
Mean ..	28·465	6·10	0·74	6·84

* These figures stand respectively as 6·63 lbs., and 8·31 lbs. in Way's original paper; the figures in this Table are more correct.

Thus on an average of three years, with a mean rainfall of 28·465 inches, we have 6·10 lbs. of nitrogen as ammonia supplied to the soil per acre each year; and in addition, on an average of two years, 0·74 lb. of nitrogen in the form of nitric acid; giving a total of 6·84 lbs. of nitrogen. If, however, we only regard the two years in which the nitric acid was actually determined, the total nitrogen becomes 7·29 lbs. per acre, equivalent to 46½ lbs. of ordinary nitrate of sodium. It must be recollected in dealing with these figures, that the analyses on which they are based were made at a time when many of the modern refinements in chemical methods were unknown. We shall by-and-by compare these results with those obtained by other chemists.

The amount of ammonia supplied to the soil by rain does not of course represent the whole amount furnished by the atmosphere; we have also to take into account the direct absorption by the soil itself. The quantity of ammonia annually absorbed from the atmosphere by a moist soil is doubtless considerable, but in the present state of our knowledge no estimate of the amount can be made; we shall, however, refer to the point again further on.

The next analyses of Rothamsted rain-water we have to notice are those made by Dr. E. Frankland, and published in the Sixth Report of the Rivers' Pollution Commission, 1874, p. 27. This series includes 71 samples of rain- and snow-water collected in the first large gauge between April 1869 and May 1870, and 7 samples of dew and hoar-frost collected within the same period. The examination to which these waters were submitted was far more complete than in any of the preceding analyses, the work in fact stands in some respects unique among investigations of the kind hitherto published. Dr. Frankland determined the total solid matter dissolved in the water, and the quantity of carbon and nitrogen existing in the form of organic matter, besides making determinations of the ammonia, nitric acid, and chlorine present; the hardness of the water was also determined. The methods of analysis employed by Dr. Frankland are described in the Appendix to the Report just mentioned, and also in the 'Journal of the Chemical Society,' 1868, p. 77.

The waters examined by Dr. Frankland were either fair samples of individual rainfalls, or represented the water collected during some part of a fall. The samples by no means represent all the rainfalls of a year, or even of any month, and the analyses are therefore insufficient for calculating the total amount of nitrogen or chlorine furnished by the rain in the course of a year; but they illustrate excellently the variations in the composition of rain-water under various conditions, which indeed was a special object of the inquiry.

It is obvious that the water falling on a rain gauge must be apt to carry with it into the receiver any impurity found on the surface of the gauge. Dust of various kinds is continually blown on to the surface of the gauge, which is also sometimes, though rarely, contaminated by the excrements of birds; small insects also frequently find their way into the collecting vessels. With the view of removing as far as possible these sources of error, certain samples of rain were collected for analysis after the surface of the gauge had been washed by distilled water; other samples were collected during the latter part of a shower, after the collecting surface had been washed by the earlier rain. The samples thus collected were for the most part received at once into clean bottles, without first entering the ordinary receiver of the gauge. Twenty-two samples of rain-water were in all collected with one or other of these precautions. The mean composition of these waters, and of the waters in the collection of which no such precautions were taken, is shown in the following Table:

TABLE X.—AVERAGE COMPOSITION of RAIN-WATER collected both from a WASHED GAUGE, and WITHOUT special PRECAUTION, in parts per Million.

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.	Hardness.*
			Organic Matter.	Ammonia.	Nitrates and Nitrites.	Total Nitrogen.		
From washed gauge, 22 samples	28·0	0·64	0·16	0·30	0·12†	0·58	2·1	4·0
Without special precaution, 47 samples	36·6	1·03	0·20	0·41	0·15‡	0·76	3·6	4·8

It would appear from these figures that the water collected from the washed gauge was distinctly purer, especially in organic carbon and chlorine, than the rain ordinarily collected. These figures, however, probably exaggerate the effect produced by the natural impurities of the collecting surface, for the majority of the 22 samples being collected during the middle or latter part of a shower, really indicate the results obtained from a partly washed atmosphere as well as from a washed gauge. The extent to which the composition of the rain is dependent on the washed or unwashed condition of the atmosphere is well illustrated by two of Dr. Frankland's analyses.

* By "hardness" is understood the total lime and magnesia in a water, expressed in parts of carbonate of calcium.

† Mean of 11 analyses. ‡ Mean of 23 analyses.

On the 11th of May, 1870, rain being anticipated, the rain gauge was washed with distilled water at 11.30 A.M.; a collection of rain was then made at 3 P.M., and a second at 4.30 P.M. These two samples of water were found to contain per million as follows:

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.
			Organic Matter.	Ammonia.	Nitrates and Nitrites.	Total Nitrogen.	
Collection at 3 P.M. ...	40·8	0·93	0·18	1·07	0·18	1·43	1·0
,, 4.30 P.M.	29·4	0·62	0·19	0·37	0·13	0·69	0·8

The second collection of rain-water is seen to be far purer than the first, the earlier rain having removed from the atmosphere much of the ammonia, chlorides, and organic dust which it previously contained.

In considering the results obtained by Dr. Frankland, it will be convenient to look in the first place at the general composition of the rain-water, and afterwards at that of the dew and hoar-frost as shown by his analyses; and then at the variations in the composition under various circumstances.

TABLE XI.—THE MAXIMUM, MINIMUM, and MEAN AMOUNTS of certain CONSTITUENTS in 69 SAMPLES of RAIN-WATER, in parts per Million.*

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.	Hardness.
			Organic Matter.	Ammonia.	Nitrates and Nitrites.	Total Nitrogen.		
Highest proportion	85·8	3·72	0·66	1·28	0·44	1·94	16·5	16·0
Lowest proportion	6·2	0·21	0·03	0·04	0·01	0·13	0·0	0·0
Mean, 69 samples	33·1	0·90	0·19	0·37	0·14†	0·70	3·1	4·7

* It should be borne in mind that the whole of these numbers are simply arithmetical means; all the figures are therefore somewhat higher than they would have been if, as before, the quantity of rainfall which each analysis represents had been taken into account (see note, page 251). The latter plan was impossible in the present case, the samples collected during the course of a shower representing no definite amount of water.

† This figure is the mean of 34 analyses. In 35 of the analyses of rain-water given by Dr. Frankland, the presence of nitric and nitrous acid is not mentioned. These acids were probably, however, in no case really absent; they appear indeed to rank among the constituents invariably present in rain-water, though often

Two of the samples of water analysed by Dr. Frankland are excluded from the mean given in the foregoing Table, and will be excluded from all subsequent discussion. They represent the collections from January 25 to 31, and from February 9 to 16, 1870. Hard frost occurred on both occasions, and hoar-frost or snow remained exposed for many days on the surface of the gauge, and doubtless became contaminated to an unusual extent with atmospheric dust, as the resulting samples of water proved very impure.

The average amount of ammonia found by Dr. Frankland is equal to only 0·37 of nitrogen per million; this is far smaller than that obtained in the earlier analyses of Rothamsted rain-water, which gave a mean of 0·95 of nitrogen as ammonia per million of water. We have already stated that Dr. Frankland's results cannot strictly be compared with those previously obtained, since his samples of rain-water did not include every fall of rain in a given period, but consisted of selected samples only. So large a difference cannot, however, be explained by the different range of the samples analysed, and we must therefore look a little farther. The methods of analysis employed at Rothamsted and by Way had probably a small error on the side of excess, due to alkali, liberated by the action of steam on the glass condensing vessels, being reckoned as ammonia; from this error Dr. Frankland's determinations made by the Nessler process would be free. Another fact to be taken into account is the interval which has elapsed between the collection and analysis of the water. Dr. Frankland's experience, we believe, points to the necessity of a speedy analysis, as the ammonia in a water is apt to diminish on keeping. To this source of error, tending to deficiency, nearly all the analyses we have recorded are more or less liable. It becomes thus impossible to judge with certainty between the results of the different experimenters. The only mode for determining with exactness the proportion of ammonia in rain-water is to make the deter-

---

existing in extremely minute quantity. Dr. Frankland has kindly informed us that the absence or presence of nitric and nitrous acid in his analyses of rain-water is to be explained by the method adopted for their determination. The amount of these acids in rain-water proved too small to be determined by the method he has usually employed in water-analysis, at least with the limited bulk of rain-water placed at his disposal; he therefore in the later analyses converted the nitric and nitrous acids into ammonia, by the well-known aluminium method, and found that in this form the minute quantity of nitric and nitrous acid could be readily determined. When employing the latter method a small quantity of nitric or nitrous acid was always found in rain-water.

In consequence of this communication from Dr. Frankland, we have disregarded the recorded absence of nitric and nitrous acid in certain of his analyses of rain and dew, and in calculating the mean quantity of nitrogen existing as nitric and nitrous acid have taken those analyses only in which nitric and nitrous acid were found.

mination immediately after the collection of the water. The determination of ammonia in a year's rainfall would on this plan require a large amount of analytical work, for which at present sufficient time has not been found at Rothamsted.

The proportion of nitrogen as nitrates and nitrites found by Professor Way and Dr. Frankland is seen to agree very nearly. Way found on an average 0·12 per million of rain, while Frankland's 34 analyses give a mean of 0·14.

The determinations of organic carbon and nitrogen are full of interest; they are, indeed, the only determinations of the kind as yet made in rain-water. The carbon and nitrogen represent the soluble matter extracted by the rain from the organic dust with which it has come in contact in the atmosphere, or on the surface of the collecting vessel. The average proportion of nitrogen to carbon when the gauge was washed before collection is 1 : 4·0; when the gauge was not washed, 1 : 5·2; the mean of all the samples is 1 : 4·8. The organic matter dissolved in rain is thus of a decidedly nitrogenous character.

The chlorine found in rain-water is due to the presence of common salt. The average amount of chlorine shown by Dr. Frankland's analyses is 3·1 parts per million.

The total solid matter dissolved in rain-water is considerably greater than the sum of the constituents mentioned in the Table; the remaining matter will consist partly of sulphates, which Dr. Angus Smith has shown form a large ingredient of rain-water.

We turn now to the analyses of dew and hoar-frost. The samples examined were seven in number. In the case of some of the samples the collection extended over several days, and embraced many distinct deposits.

TABLE XII.—The MAXIMUM, MINIMUM, and MEAN AMOUNTS of certain CONSTITUENTS in SEVEN SAMPLES of DEW and HOAR-FROST, in parts per MILLION.

	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.	Hardness.
			Organic Matter.	Ammonia.	Nitrates and Nitrites.	Total Nitrogen.		
Highest proportion	80·0	4·50	1·96	2·31	0·50	4·55	8·0	25·0
Lowest proportion ..	26·4	1·95	0·26	1·07	0·28	1·66	3·5	13·0
Mean, 7 samples ..	48·7	2·64	0·76	1·63	0·40*	2·79	5·3	19·0

* Mean of 4 analyses.

These small deposits, condensed from the lower stratum of the atmosphere, contain on an average three or four times the amount of organic carbon, organic nitrogen, ammonia, and nitric acid, found in the analyses of rain-water. The total quantity of solid matter, and the amount of chlorides, is also larger, but the difference is much smaller than in the case of the other ingredients. The mean proportion of organic nitrogen to carbon is 1 : 3·5.

We must now consider briefly the variations in the composition of the Rothamsted rain-waters displayed in Dr. Frankland's analyses. The extent of variation in 69 samples has been already given in Table XI. A glance at this Table will at once show that the amount of variation is enormous; and the range of difference becomes still larger if we include in the same view the small deposits of dew and hoar-frost.

As the composition of rain-water greatly depends on the quantity of the fall, we shall in the first place classify the analyses according to the quantity of rain which they represent, and next according to the season of the year in which they fell. Only fifty-four of the samples analysed by Dr. Frankland fairly represented a known quantity of rainfall, but in the case of four other samples the bulk of the sample bore such a high proportion to the bulk of the rainfall that it may be accepted as a tolerably fair representation of the whole fall. From the whole number two analyses are omitted for reasons already given; there remain therefore fifty-six available for discussion.

In the upper division of Table XIII. the whole of the analyses of rain-water are arranged according to the quantity of the fall which they represent. It is evident on considering this division that the proportion of each constituent tends to diminish as the amount of rainfall increases, the decrease being most rapid in the case of the chlorides, and least marked in the case of the organic elements. The quantity of nitrogen as nitrates and nitrites is frequently the mean of so few analyses that the figures are necessarily irregular.

Since the quantity of the fall exercises such a preponderating influence on the composition of the rain-water, it is clear that in tracing out other conditions affecting the composition of the water we should only compare together analyses which represent *rainfalls of similar amount*, a truth which, though self-evident, has been very much overlooked in discussions of this nature.

In the second and third divisions of the Table the analyses are still arranged according to the quantity of the fall, but they are now divided so as to show the differences between the rain of summer and winter. The series of analyses we are now discussing is by no means favourable for the exhibition of differ-

ences of composition due to season, very few of the samples having been collected either in the height of summer or the depth of winter. Thus out of the fifty-six samples there is not one collected in August, and but one in July; there is but one in December, and there are only two each in November and January. The most abundant collections were in May, April, and September, among the summer months, and in February, March, and October, among the winter months.

TABLE XIII.—The COMPOSITION of RAIN-WATER in relation to the AMOUNT of RAINFALL and SEASON of the YEAR.

Quantity of Rainfall.	Number of Samples.	Total Solid Matter.	Carbon in Organic Matter.	Nitrogen as				Chlorine.
				Organic Matter.	Ammonia.	Nitrates and Nitrites.*	Total Nitrogen.	
In the WHOLE YEAR.								
Below ·10 inch	22	38·2	0·95	0·21	0·46	0·12	0·79	4·2
From ·10 to ·20 inch ..	20	36·9	1·19	0·23	0·44	0·17	0·84	3·5
From ·20 to ·40 inch ..	7	34·9	0·74	0·14	0·23	0·11	0·48	1·8
From ·50 to ·90 inch ..	7	21·5	0·71	0·12	0·26	0·18	0·56	1·5
In the SUMMER MONTHS, APRIL to SEPTEMBER.								
Below ·10 inch	10	42·2	1·10	0·17	0·48	0·17	0·82	3·2
From ·10 to ·20 inch ..	14	41·9	1·18	0·18	0·43	0·18	0·79	3·6
From ·20 to ·40 inch ..	4	42·6	1·01	0·15	0·25	0·12	0·52	2·3
From ·50 to ·90 inch ..	4	26·3	0·97	0·11	0·35	0·38	0·84	1·9
In the WINTER MONTHS, OCTOBER to MARCH.								
Below ·10 inch	12	35·0	0·83	0·25	0·44	0·10	0·79	5·0
From ·10 to ·20 inch ..	6	25·1	1·22	0·33	0·48	0·16	0·97	3·3
From ·20 to ·40 inch ..	3	24·6	0·39	0·13	0·20	0·09	0·42	1·2
From ·50 to ·90 inch ..	3	15·1	0·37	0·14	0·14	0·08	0·36	0·9

Notwithstanding, however, the small number, and partial distribution of the samples available for discussion, the result

* The figures for the nitrogen present as nitrates and nitrites are the means of determinations made in the following samples:—

Below ·10 inch	Summer, 2;	Winter, 8;	Whole Year, 10	samples.
From ·10 to ·20 inch ..	,, 7	,, 6	,, ,, 13	,,
From ·20 to ·40 inch ..	,, 1	,, 1	,, ,, 2	,,
From ·50 to ·90 inch ..	,, 1	,, 2	,, ,, 3	,,

of their classification into summer and winter periods is generally consistent and full of interest. In every case the amount of total solid matter dissolved in the rain-water is considerably greater in summer than in winter. In a majority of cases the ammonia is greater in summer than in winter. The nitric acid is also in every case greatest in summer-time, though the figures are very irregular, owing to the small number of analyses at command. The general distribution of ammonia and nitric acid is thus the same as that shown in the earlier analyses of Rothamsted rain-water.

The most striking difference in the two seasons occurs in the organic matter. The total organic matter is in a majority of cases greater in summer than in winter; its composition, however, is quite distinct. In summer the carbon is generally greater than in winter, while the nitrogen in summer is less than in winter. The proportion of nitrogen to carbon is thus very different at the two seasons of the year, as will appear more clearly from the following Table:

Table XIV.—Average proportion of Organic Nitrogen to Carbon in Rainfalls of different Amount, and collected at different Seasons of the Year.

Quantity of Rainfall.	Summer.	Winter.	Whole Year.
Below ·10 inch	1 : 6·4	1 : 3·4	1 : 4·5
Between ·10 and ·20 inch	1 : 6·5	1 : 3·7	1 : 5·3
Between ·20 and ·40 inch	1 : 6·8	1 : 2·9	1 : 5·3
Between ·50 and ·90 inch	1 : 8·8	1 : 2·7	1 : 5·8

The simplest explanation of these facts seems to be that in summer-time the organic matter in rain-water contains a larger proportion of fresh vegetable matter than in winter; in the latter season the organic impurity must consist chiefly of products of decay.

The arrangement of the few analyses of dew and hoar-frost in summer and winter groups shows, as in the case of rain, a preponderance of total solid matter, of organic matter, and of ammonia, in the summer months, but the series is too small for detailed discussion.

Dr. Frankland has paid considerable attention in his Report to the influence of various winds on the composition of the rain-water collected at Rothamsted. The question obviously presents considerable difficulty. To compare under equal conditions the rain produced by different winds, we must clearly

only compare rains of similar quantity, and falling in a similar season of the year. This can hardly be done to any practical extent with the small series of analyses now before us. The chief points insisted on by Dr. Frankland, namely, that the south-east wind produces rain richest in ammonia, and the north-east wind rain richest in chlorine, are probably correct. London lies to the south-east of the rain-gauge; the south-east wind, which is naturally rich in ammonia, may probably derive some addition to its contents from this source. To the north-east of the gauge lies the nearest wide expanse of ocean—the North Sea; it is easy therefore to understand that winds from this direction should supply the largest proportion of chlorides.

The last investigation on the Rothamsted rain-waters which we have to mention is one now in progress respecting the quantity of chlorides present in the annual rainfall. This investigation commenced in June 1877, and has been continued down to the present time. A proportion of each day's rain, at the rate of one gallon for every inch of rainfall, has been set aside in a glass carboy provided for the purpose. At the end of each month the contents of the carboy are well mixed, and a sample is taken for analysis.

The chlorine has been determined by the volumetric method employed by Dr. Frankland. The amount of chlorine present being often extremely small, and the results obtained when working on the unconcentrated water depending greatly on the conditions of the experiment, the greater part of the determinations has been made on water concentrated in a glass basin. One litre of rain-water, with 10 cubic centimetres of lime-water (since May 1880, 5 cubic centimetres have been employed), have been evaporated over a gas burner to rather less than one-quarter litre, then filtered, and the clear liquid diluted with distilled water till exactly one-quarter of a litre in volume; in this solution chlorine has then been determined by the method already mentioned. This mode of working gave much sharper results. We have, however, quite recently found that the chlorine determined on this plan is somewhat below the true amount. We therefore now concentrate two or three litres of the rain with a little lime-water to a small bulk, filter, precipitate with nitrate of silver, and collect and weigh the precipitate. Eight monthly determinations of chlorine in rain-water made by this gravimetric method have given a mean of 2·89 parts of chlorine per million, while the results of the volumetric method for the same months show a mean of 2·73 of chlorine per million.

In the following Table will be found the monthly determinations of chlorine made by the volumetric method. The results,

TABLE XV.—MONTHLY DETERMINATIONS of CHLORINE in RAIN-WATER, during 43 MONTHS, 1877–80.

	1877.			1878.			1879.			1880.		
	Rainfall.	Chlorine per Million of Rain.	Chlorine per Acre.	Rainfall.	Chlorine per Million of Rain.	Chlorine per Acre.	Rainfall.	Chlorine per Million of Rain.	Chlorine per Acre.	Rainfall.	Chlorine per Million of Rain.	Chlorine per Acre.
	Inches.		lbs.	Inches.		lbs.	Inches.		lbs.	Inches.		lbs.
January	..	..	..	1·750	2·91	1·15	2·849	3·04	1·96	0·550	3·20	0·40
February	..	..	..	1·804	0·50	0·20	3·799	1·83	1·57	2·901	3·20	2·10
March	..	..	..	0·977	4·00	0·88	1·183	5·80	1·55	1·128	2·90	0·74
April	..	..	..	4·093	0·55	0·51	2·790	1·67	1·05	2·161	1·73	0·85
May	..	..	..	4·976	0·91	1·03	3·481	1·40	1·10	0·742	3·43	0·58
June	1·435	1·95	0·63	2·505	1·48	0·84	5·551	0·80	1·01	1·966	1·80	0·80
July	3·284	0·24	0·18	0·656	4·31	0·64	4·244	0·80	0·77	5·261	0·10	0·12
August	2·596	0·95	0·56	4·976	1·16	1·31	6·558*	0·85	1·26	1·069	1·30	0·31
September	1·529	1·73	0·60	1·462	2·28	0·75	3·131	1·05	0·74	5·858	0·97	1·29
October	1·950	3·40	1·50	2·987	2·58	1·74	0·815	2·65	0·49	5·939	3·00	4·03
November	5·159	1·97	2·29	4·545	1·83	1·88	0·814	9·38	1·73	2·919	2·95	1·95
December	2·279	1·96	1·01	1·601	3·00	1·09	0·823	5·75	1·07	3·472	1·70	1·34
Totals and Averages	18·232	1·64	6·77	32·332	1·64	12·02	36·038	1·75	14·30	33·966	1·89	14·51

* The sample actually taken for analysis represented only 3·55 inches; the water collected by the large Rain-gauge on August 2–3, having been contaminated by the flood which surrounded the gauge, was rejected.

though a little below the truth, are at least comparable amongst themselves, and exhibit some interesting features.

The range in the amount of chlorides shown by these analyses is very considerable. Thus the rain of July 1880 contained, by the method of analysis here employed, only 0·10 part of chlorine per million of water, while the rain and snow of November 1879 contained 9·38 parts of chlorine. The latter figure is, however, quite exceptional, and suggests a possible contamination of the water. The second highest amount reached in the forty-three months is much lower, namely, 5·80 parts of chlorine. The average proportion of chlorine in the rain-water during the whole period is 1·75 per million. The quantity of chlorine brought by the rain on to an acre of land in the course of a year (average of 3½ years) is 13·42 lbs., for a rainfall of 34·038 inches, equal to 22·12 lbs. of pure common salt. All these figures, as already mentioned, are somewhat below the truth.

With the view of throwing light on the cause of variation in the proportion of chlorides, we proceed as before to classify the analyses according to the amount of rainfall, and according to the season of the year.

TABLE XVI.—AVERAGE PROPORTION of CHLORINE in MONTHLY RAINFALLS of different AMOUNT, and at different SEASONS of the YEAR, in parts per Million.

Monthly Rainfall.	Summer.	Winter.	Whole Year.
Below 1 inch	3·87	5·00	4·67
Between 1 and 2 inches ..	1·81	3·09	2·51
Between 2 and 3 „ ..	1·46	2·75	2·17
Between 3 and 4 „ ..	0·90	1·77	1·24
Between 4 and 5 „ ..	0·86	1·83	1·05
Above 5 inches	0·68	2·48	1·28

These figures plainly exhibit two facts: first, that the proportion of chlorides, as of all the other constituents of rain-water, rapidly diminishes as the quantity of the rainfall increases; and second, that the proportion of chlorides is much higher in the winter than in the summer months. The latter fact is consistently shown in every part of the comparison between summer and winter rainfalls given in the above Table. We have already stated that the average proportion of chlorine in the rain of the whole year is 1·75 per million; but the

average proportion for the six winter months is 2·70, and for the six summer months 1·06 per million, or less than one-half the winter proportion. This striking difference between the amount of chlorine in the summer and winter rainfall is not shown in Dr. Frankland's analyses of the Rothamsted rain-water. We have, however, already noticed that the series of samples analysed by him was not well suited for the exhibition of summer and winter characteristics. The cause of the excess of chlorides in the winter rain is probably to be found in the more stormy character of this season, and perhaps also in the coal smoke which then affects the atmosphere.

We must not conclude our remarks on the composition of rain-water without a very brief glance at the results of other experimenters.

The best idea of the variations which may occur in the compostion of rain-water from the different degrees of impurity in the atmosphere from which it is collected, is afforded by the researches of Dr. Angus Smith ('Air and Rain; the beginnings of a Chemical Climatology,' 1872). In this work will be found the results of numerous analyses of rain-water, collected both from country districts and towns in the United Kingdom. The average results obtained for a few districts are given in the following Table:

TABLE XVII.—AVERAGE COMPOSITION of SAMPLES of RAIN from various districts of ENGLAND and SCOTLAND, in parts per Million.

DISTRICT.	Nitrogen as		Chlorine.	Sulphuric Acid.
	Ammonia.	Nitric Acid.		
England, country places, inland ..	0·88	0·19	3·88	5·52
" towns	4·25	0·22	8·46	34·27
Scotland, country places, sea-coast	0·61	0·11	12·24	5·64
" " " inland	0·44	0·08	3·28	2·06
" towns	3·15	0·30	5·70	16·50
" Glasgow	7·49	0·63	8·72	70·19

The amounts of ammonia and nitric acid in the rain from "country places," are seen to be similar to those found in the Rothamsted rainfall. In the rain of towns there is a very large increase both in ammonia and sulphuric acid, and a smaller, though considerable, increase in chlorides and nitrates.

Chlorides reach their maximum in the rain collected at the sea-coast. In the rain from Valentia, on the west coast of Ireland, Dr. A. Smith found 47·35 parts of chlorine per million.

Few quantitative determinations have been made of the amount of chlorides furnished to the soil by rain. A long series of observations on this subject has been carried out at the Royal Agricultural College, Cirencester. The determinations were commenced in 1870 by Professor Church, and have since been continued by Professor Prévost. Through the kindness of these gentlemen we are able to refer to the results. The mean rainfall from October to March during ten years has been 16·801 inches, containing an average of 5·11 parts of chlorine per million of water. The mean rainfall from April to September has been 16·770 inches, containing an average of 3·46 parts of chlorine per million. For the whole year the mean rainfall has been 33·571 inches, the chlorine amounting to 4·28 parts per million, equal to 53·66 lbs. of pure common salt per acre. It will be observed that the amount of chlorine is, on an average, greatest in the winter months; this, however, is largely due to the result obtained in one winter of the series. Cirencester is about 35 miles from the Bristol Channel; the amount of chlorides in the rain is thus naturally higher than at Rothamsted.

The amount of ammonia and nitric acid supplied to the soil in rain in the course of a year has been determined in various parts of the continent of Europe. The results of twenty-two determinations, each extending over a whole year, and made at eleven different stations, will be found in Table XVIII. (p. 268).

The large amount of nitric acid found in many of these rain-waters is remarkable. It would appear also, from the results at Regenwalde and Montsouris, that the quantity of nitric acid may vary extremely from year to year in the same place. Are we to assume that the large quantities of nitric acid indicated have been produced by the union of atmospheric nitrogen and oxygen under electrical influences, or chiefly through the oxidation of the ammonia of the air by means of ozone or peroxide of hydrogen? The latter alternative seems the most probable.

It is seen that the numerous widely varying determinations, some made in the vicinity of towns, give a mean of 10·23 lbs. of combined nitrogen annually supplied per acre by rain, with a mean rainfall of 27·03 inches. The two years' determinations of both the ammonia and the nitric acid in the rain at Rothamsted give, as has been seen, 6·58 lbs. and 8·00 lbs. of combined nitrogen as the annual supply per acre from the same source.

Making all allowance for far inland open country positions on the one hand, and for proximity to towns on the other, the very small amounts of combined nitrogen so supplied per acre

in some of the case recorded in the Table, and the comparatively large quantities in others, seem difficult to explain, or to reconcile with one another. Nor do the results become more intelligible when considered in relation to those discussed in the foregoing pages, and to the comparatively limited and

TABLE XVIII.—DETERMINATIONS of the QUANTITY of NITROGEN supplied by RAIN, as AMMONIA and NITRIC ACID, to an ACRE of LAND, during ONE YEAR.

STATION.	Rainfall.	Nitrogen per Million, as		Total Nitrogen per Acre.
		Ammonia.	Nitric Acid.	
	inches.			lbs.
Kuschen, 1864–5	11·85	0·54	0·16	1·86
„ 1865–6	17·70	0·44	0·16	2·50
Insterburg, 1864–5	27·55	0·55	0·30	5·49
„ 1865–6	23·79	0·76	0·49	6·81
Dahme, 1865	17·09	1·42	0·30	6·66
Regenwalde, 1864–5	23·48	2·03	0·80	15·09
„ 1865–6	19·31	1·88	0·48	10·38
„ 1866–7	25·37	2·28	0·56	16·44
*Ida-Marienhütte; mean of 6 years, 1865–70	22·65	..	..	9·92
Proskau, 1864–5	17·81	3·21	1·73	20·91
Florence, 1870	36·55	1·17	0·44	13·36
„ 1871	42·48	0·81	0·22	9·89
„ 1872	50·82	0·82	0·26	12·51
Vallombrosa, 1872	79·83	0·42	0·15	10·38
Montsouris, Paris, 1877–8	23·62	1·91	0·24	11·54
„ 1878–9	25·79	1·20	0·70	11·16
„ 1879–80 ..	15·70	1·36	1·60	10·52
Mean of 22 years	27·03	..	..	10·23

uniform amounts recorded for Montsouris, within the walls of Paris. As to the higher amounts, it is true that Liebig, in his earlier writings, assumed the probability of a very much larger quantity of ammonia coming down in rain than any indicated in the above Table, or than he did subsequently; and even in his more recent work, 'The Natural Laws of Husbandry,' published in 1863, he supposes that as much as 24 lbs. of nitrogen per acre may be annually available to vegetation from that source. It will be observed, however, that neither do the early results for the open country obtained by Boussingault, nor do those obtained at Rothamsted, indicate more than about one-third of this amount; and the more recent determinations in the Rothamsted rain-waters point to less rather than more than the earlier ones.

* Details of these results are not at hand. The rainfall given is really the average of seven years, 1864–70.

Part II. The Amount and Composition of the Drainage-Waters from unmanured Fallow Land.

In any inquiry respecting the influence of drainage in practical agriculture, it is clearly of primary importance to ascertain what proportion of the rainfall passes in each season through known depths of soil; we shall therefore in the first place describe the experiments relating to this part of the subject.

The amount of drainage-water passing through any soil depends—1. On the amount of the rainfall. 2. On the physical condition of the soil, its permeability, and water-holding power. 3. On the amount of evaporation taking place, which latter is determined by the temperature of the soil and air, and by the capillary power of the soil, and is greatly increased when a crop is growing on the surface.

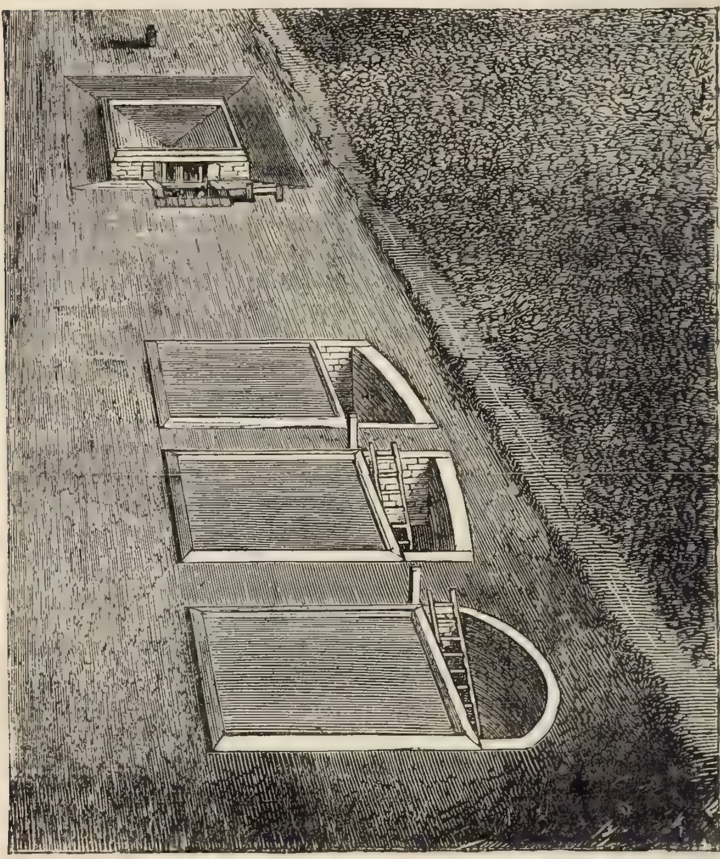
The experiments we are about to describe were made to ascertain the amount of natural drainage through the Rothamsted soil when kept bare of vegetation; the effect of a crop is thus for the present excluded. The drainage-waters obtained have been analysed; their composition will be found to illustrate in a striking manner the loss of plant food which an uncropped soil may suffer from the percolation of rain-water.

1. *The Drain-Gauges.*—The drain-gauges which have been constructed are three in number; they consist of rectangular plots of soil, each 6 feet by 7 feet 3 inches, having thus the same surface as that of the large rain-gauge, namely 1-1000th of an acre. The depth of the soil varies. In the first gauge the depth is 20 inches; in the second it is 40 inches; and in the third 60 inches.

In order to obtain a natural drainage, it was of primary importance that the soil should be in a perfectly natural condition of consolidation, neither more porous nor more condensed than ordinary field soil. To accomplish this object a deep trench was dug along the front of each intended gauge; the mass of soil was then gradually undermined at the depth previously determined, and plates of cast-iron, 8 inches wide and perforated with holes, were introduced to support the soil as the work proceeded. This perforated iron bottom was finally strengthened by transverse iron girders, and the ends of the plates and girders supported by brickwork on three sides of the intended gauge. The soil being now supported from beneath, trenches were made one by one on the three remaining sides of the block of soil to be isolated; walls of brick, laid in cement, 4½ inches thick, were built against the soil, and the trenches were again filled in with earth. The mass of soil was in this manner built in on all sides with brick and cement. The surrounding walls were

carried 3 inches above the level of the soil, the edges at the top being made to slope outwards. A sketch of the three drain-gauges will be found in Fig. 2, which also shows the position of the large and small rain-gauges.

Fig. 2.—*View of the Rain- and Drain-gauges.*



At about 1 foot 6 inches below the perforated iron bottom is fixed a large zinc funnel, of the same area as the soil above it; the drainage-water from the soil falls on to this funnel, and is received in suitable vessels placed beneath. During the first three years the water was collected in glass carboys, and its quantity determined by weight; but since December, 1873, galvanised-iron cylinders, fitted with external gauge tubes, have been employed for receiving and measuring the water; these cylinders are quite similar to those used for the large rain-gauge.

The drain-gauges just described were constructed in Barnfield; and the new large rain-gauge was afterwards constructed in their immediate neighbourhood. The soil at Rothamsted consists generally of a somewhat heavy loam, with a subsoil of clay, both mixed with flints, and lying on chalk, which, however, seldom comes very near the surface. In the present case the cultivated soil of the field was about 8 inches in depth; this was succeeded by about 10 inches of friable clay, followed by subsoil of rather stiff clay. The whole of the experimental soil was above the chalk. The land had previously been under the ordinary arable culture of the farm.

The gauges were constructed in the summer of 1870; since then a few alterations have been made. In November and December 1874, leakage from the outside being feared, the sides of the gauges were bared, the old walls coated with cement, and then thickened by an additional half-brick. Again, in February 1879, the drainage from the 20-inch gauge appearing very excessive, one of the walls was bared in which a leak was suspected, and its external surface coated with cement.

2. *The Measured Drainage, and the Evaporation.*—The amount of the monthly drainage through each of the three gauges, from September 1870 to the end of 1880, is shown in Table XIX.*

The monthly drainages recorded in Table XIX. are in a few cases not those actually recorded, but a corrected figure. For instance, the recorded drainage from the 20-inch gauge in February 1879 was 5·734 inches: this amount was greatly above that of the other gauges, and there being some evidence of leakage from the outside, the record has been rejected, and the amount passing through the 40-inch gauge substituted in its place. Again, in the tremendous rainfall of August 2–3, 1879, some of the receivers overflowed, and one was floated and disconnected by the rise of water in the chamber under the gauges. In this instance, and in some others of a somewhat similar kind, an estimated drainage deduced from a consideration of the amount of rainfall, and other facts of the case, has been adopted in place of the observed drainage, which was obviously incorrect. Another source of error has arisen from unequal drifts of snow on the surface of the three gauges. Thus, in April 1878, the recorded drainage through the 20-, 40-, and 60-inch gauges was respectively 2·249, 2·822, and 3·467 inches; but as the receivers of the 20-inch gauge ran over slightly, while a small snowdrift had occurred on the surface of the 40-inch gauge, and a

* A summary of the results for the first five harvest-years (Sept. 1 to Aug. 31 inclusive) was given at a meeting of the Institution of Civil Engineers, Feb. 29, 1876, and is published with a few comments in the 'Minutes of Proceedings' of the Institution, vol. xlv., part iii.

TABLE XIX.—THE AMOUNTS of MONTHLY PERCOLATION through SOILS 20, 40, AND 60 INCHES DEEP.

MONTHS.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	Av. 10 ys. 1871–80.
SOIL 20 INCHES DEEP.												
	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.	inches.
January		0·254	3·641	2·769	1·216	2·871	1·463	3·793	1·101	2 470	0·482	2·006
February	..	0·913	0·641	0·708	0·850	0·341	1·874	0·869	1·013	[4·438]	2·360	1·401
March	..	0·337	0·920	0·884	0·009	0·499	1·283	1·014	0·273	0·138	0·038	0·540
April	..	0·811	0·089	..	0·319	0·085	[1·360]	1·327	2·349	1·270	0·493	0·810
May..	..	0·002	0·778	..	..	0·290	0·003	0·445	1·479	1·217	0·002	0·422
June	..	1·294	0·769	..	..	0·349	..	0·026	0·611	2·156	0·010	0·521
July..	..	0·809	0·006	0·625	[0·420]	3·292	..	0·560	0·009	1·828	1·352	0·890
August	..	0·002	0·018	..	..	0·001	0·146	0·384	1·331	[4·601]	0·214	0·670
September	0·216	1·821	0·004	0·704	0·634	0·890	2·296	0·205	0·075	1·110	3·964	1·170
October	1·070	0·118	3·134	0·992	1·525	3·715	0·823	0·580	1·370	0·221	4·466	1·694
November	1·839	0·069	2·854	1·080	1·209	3·238	2·886	4·031	3·771	0·195	2·244	2·158
December	2·094	0·818	3·375	0·156	1·155	0·785	5·212	1·742	1·108	0·413	2·814	1·758
Total	5·219	7·248	16·229	7·918	7·337	16·356	17·346	14·976	14·490	20·057	18·439	14·040
SOIL 40 INCHES DEEP.												
January	..	1·124	3·552	2·729	1·353	3·385	1·758	4·411	1·362	2·652	0·611	2·294
February	..	1·136	0·771	0·544	0·842	0·442	2·204	1·191	1·203	4·438	2·591	1·536
March	..	0·426	0·825	1·017	0·038	0·566	1·745	1·252	0·503	0·284	0·095	0·675

April		0·797	0·163	0·006	0·292	0·113	1·664	1·613	[2·524]	1·508	0·533	0·921
May		0·046	0·753	..	..	0·371	0·035	0·548	1·848	1·393	0·021	0·501
June		1·146	0·741	..	..	0·262	..	0·096	0·856	2·239	0·008	0·535
July..		0·849	0·006	0·476	[0·448]	3·661	..	0·514	0·032	1·965	1·229	0·918
August		0·009	0·017	0·002	..	0·025	0·141	0·387	1·169	[4·598]	0·279	0·663
September	0·063	1·424	0·017	0·378	0·249	0·829	2·236	0·254	0·122	0·998	3·931	1·044
October	0·453	0·240	2·677	0·835	1·258	3·950	1·097	0·505	1·391	0·422	4·448	1·682
November	1·421	0·144	2·806	1·109	1·045	3·541	2·991	4·201	4·067	0·116	2·387	2·241
December	1 950	0·759	3·402	0·111	1·340	[1·012]	5·741	1·982	1·374	0·490	2·852	1·906
Total	3·887	8·100	15·730	7·207	6·865	18·157	19·612	16·954	16·451	21·103	18·985	14·916

Soil 60 inches deep.

January		0·724	3·131	2·713	1·207	2·615	1·671	4·106	1·200	2·472	0·457	2·030
February		0·706	0·581	0·550	0·735	0·381	1·944	1·233	1·132	4·218	2·301	1·378
March		0·231	0·829	0·802	0·034	0·462	1·585	1·105	0·458	0·257	0·085	0·585
April		0·633	0·127	0·005	0·248	0·062	[1·720]	1·486	[2·428]	1·375	0·434	0·852
May		0·035	0·629	..	..	0·304	0·028	0·510	1·502	1·297	0·028	0·433
June		0·898	0·764	..	..	0·140	..	0·102	0·755	2·185	0 020	0·486
July		0·600	0·016	0·372	[0·334]	3·346	..	0·440	0·063	1·806	1·062	0·804
August		0·002	0·027	0·001	..	0·030	0·025	0·313	1·129	[4·346]	0·221	0·609
September	0·018	1·077	0·011	0·200	0·212	0·707	2·041	0·207	0·113	0·920	3·779	0·927
October	0·183	0·229	2·098	0·290	1·024	3·551	0·955	0·389	1·103	0·426	4·070	1·414
November	0·705	0·349	2·438	0·859	0·687	3·265	2·660	3·824	3·665	0·099	2·141	1·999
December	1·072	0·479	3·046	0·039	1·039	[0·972]	5·252	1·752	1·542	0·442	2·681	1·724
Total	1·978	5·963	13·697	5·831	5·520	15·835	17·881	15·467	15·090	19·843	17·279	13·241

heavy one on the surface of the 60-inch gauge, the figures for the month have been corrected; the record of the 20-inch gauge, where there was no drift, being adopted for the other gauges for those days of the month during which the thawing of the snow occurred. The records thus altered appear in the Table as 2·349, 2·524, and 2·428 inches respectively. In all cases in which the correction has been sufficiently large to become important, the figure in the Table will be found enclosed in a bracket.

In a few cases, as in November 1870, February 1879, and January 1880, the monthly drainage from some of the gauges has exceeded the monthly rainfall. Generally this has been more or less due to rain, or especially snow, falling at the end of one month and appearing as drainage in the next. It occasionally happens also in severe winters that a considerable amount of frozen water is retained in the upper layer of the soil for some time, and appears as drainage only when a complete thaw takes place. There is, however, another possible explanation of excessive drainage in relation to rainfall, namely, the condensation of water by the soil directly from the atmosphere. That such condensation must take place whenever the temperature of the soil is below the dew-point of the atmosphere is quite plain.* During a clear frosty night both rain-gauge and soil will condense water from the atmosphere, and the soil, perhaps, somewhat the more. It seems, however, very probable that after a long-continued frost, followed by mild weather, the soil may continue for some time to condense from the air very appreciable quantities of water of which the rain-gauge will give no account. There is some evidence, which will be mentioned by-and-by, that such a condensation of water took place in the soils of the drain-gauges during the severe winters of 1878–9 and 1879–80. The total amount of water obtained by the soil from the atmosphere without the records of the rain-gauge being affected, is probably, however, save in exceptional seasons, not considerable. We shall have some evidence further on that the condensation by soil during the winter months is at all events no greater than the condensation by a water-surface.

Before discussing the results obtained in the drainage experiments, it will be well to consider briefly what takes place when rain falls upon a soil. It would be a mistake to regard an ordinary soil as a uniform porous mass, which simply becomes saturated with water, and then parts with its surplus by drainage; soil is, in fact, penetrated by innumerable small channels, and through these more or less of the drainage always

* A soil baked by a summer sun may re-absorb a certain amount of water from the air during the night without its temperature falling below that of the air; but the water thus absorbed is hygroscopic and will not appear as drainage.

takes place. Some of these channels consist of surface-cracks, which, becoming partly filled with sand and small stones, remain partially open after dry weather has ceased. The deeper channels are, however, not of this character, but are produced by the roots of plants, or to a still greater extent by the burrowing of worms. The soil drain-gauges we are now concerned with have furnished illustrations of both these actions. During the digging of the trenches round the gauges, barley-roots were observed penetrating the soil to a depth of 50 or 60 inches. When such roots decay, a small open channel is left through which drainage can take place. The burrowing of worms in the soil of the drain-gauges has proved a source of trouble in the collection of pure drainage-waters. Worms have not unfrequently appeared on the collecting funnel of the 20-inch gauge, having come through the soil above; and what appear to be worm-casts, dropped from the holes of the perforated iron plates, are of still more frequent occurrence. Worms have also appeared, though much more rarely, on the collecting funnels of the 40- and 60-inch gauges. The holes made by worms thus descend to a considerable depth, and if sufficiently numerous, must have an important influence on drainage.

The drainage-water from a soil may thus be of two kinds: it may consist (1) of rain-water which has passed, with but little alteration in composition, down the open channels of the soil; or (2) of the water discharged from the pores of a saturated soil. This latter water, the true drainage of the soil, will itself escape to a greater or less extent through the channels already mentioned. The respective proportions of *direct* and *general* drainage will vary much in different soils, and under different circumstances. In a light soil, of naturally free drainage, channels can play but an insignificant part, the rain being at once absorbed by the main body of the soil, and freely discharged again from its pores when saturated. In heavy soils, on the other hand, both the absorption and the discharge of water can take place but slowly, and the part which natural channels play in freeing the soil of water is more considerable. In a heavy soil direct channel-drainage will in most cases precede general drainage, a portion of the water escaping by the open channels before the body of the soil has become saturated; this will especially be the case if the rain fall rapidly, and water accumulates on the surface. When the soil is saturated, general drainage will become active. After rain has ceased, and the surface is free from standing water, the drainage which occurs will be entirely due to the general discharge from the saturated soil. The two kinds of drainage-water here mentioned differ much in composition, the direct channel-drainage containing a much

smaller proportion of soluble salts than is found in the true discharge from the soil. This difference in composition has been very frequently exemplified in the analyses of the Rothamsted drainage-waters, and has enabled us to trace the distinction between these two classes of drainage-water.

When rain has ceased, and a period of dry weather occurs, water will begin to evaporate from the surface of the soil; the water in the subsoil will be gradually drawn up by capillary attraction as the surface dries, and be itself in turn evaporated. The depth to which the subsoil will be dried by this loss of water through capillary attraction will depend on the mechanical texture of the soil; the depth will be greater in the case of a loam or clay than in the case of a soil of more open texture, the height to which water can be raised by capillary attraction being in proportion to the fineness of the spaces through which it passes.

It is obvious that in the case of a soil like that at Rothamsted, having a subsoil of clay not many feet in depth, resting upon chalk tending constantly to drain it, the conditions affecting the discharge of water from the land within a limited depth from the surface will be in the main very different from those occurring in a soil having a considerable depth of retentive clay. In the former case, the discharge within, or not far below, the usual limits of artificial drainage, will in a much greater degree depend on the direct downward passage of water, and much less on the raising of the point of saturation from below. It is further obvious that in a soil so naturally drained, the greater the amount of rainfall in a given season, the greater will be the depth to which a given amount of water will pass, while in a season of smaller rainfall the depth of penetration will be less. We should expect, therefore, that in a dry season the percolation would be greater through 20 than through 40, and greater through 40 than through 60 inches of soil. In a wet season, on the other hand, the amount of percolation would be relatively increased at the lower depths, and would tend towards equality. This would be the case if no interfering circumstances were imported into the question by the fact of absolutely cutting off the blocks of soil at different depths, thereby preventing the possibility of capillary attraction acting and water returning upwards from below the point at which the cutting off had taken place. Another consequence of this cutting off would be to cause a more complete drying of the soil 20 inches deep during dry periods than of that to a corresponding depth in the deeper gauges. The shallower soil would therefore require more water to saturate it to the same depth when subsequent rains came, and hence the amount of water

percolating through it would be less than would otherwise be the case. It must also be borne in mind that the total amounts of water retained by the different thicknesses of soil would be very different, and would vary in relation to one another at different times. It is to be regretted that our data do not enable us to estimate accurately the influence of these various circumstances. Unfortunately, too, the results obtained by the experimental drain-gauges of different depths are somewhat anomalous, and such as do not seem capable of satisfactory explanation by the aid of the various considerations above referred to.

On looking at Table XIX. it will be seen that up to the end of 1874, the drainage from the 40-inch gauge was on the whole somewhat less than that from the 20-inch gauge, and that from the 60-inch gauge was distinctly less than that from the 40-inch gauge. In November and December 1874 the walls surrounding the experimental soils were, as already mentioned, covered externally with cement, and then thickened by an additional half-brick. Since this time the relative proportions of the drainage from the three gauges have been different. The 40-inch gauge has given on an average considerably more drainage-water than the 20-inch gauge, while the 60-inch gauge has given much less than the 40-inch, and nearly the same quantity as the 20-inch gauge. The exact state of matters during the two periods of the experiment will be seen from the following Table (XX.):—

Table XX.—The Average Annual Rainfall and Drainage through 20, 40, and 60 Inches of Soil, during the Periods 1871–74, 1875–80, and 1871–80.

	Rainfall.	Drainage in Inches.			Drainage for 100 Rainfall.		
	Inches.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.
Four Years, 1871–74	27·344	9·683	9·476	7·753	35·4	34·7	28·4
Six „ 1875–80	34·189	16·944	18·544	16·899	49·6	54·2	49·4
Ten „ 1871–80	31·451	14·040	14·916	13·241	44·6	47·4	42·1

On looking at the column for rainfall it will be observed that the last six years have been much wetter than the preceding four. We expect therefore to find a greater divergence between the amounts of drainage from the three gauges during the first four years than during the last six. The considerable increase of rainfall in the latter period thus helps to explain

the near approachment of the drainage from the 20-inch and 60-inch gauges during this time, but it fails to explain the fact that the 40-inch gauge has during the same period furnished so much more drainage than either of the others. As these differences do not seem to be adequately explained by the considerations above referred to, we must either assume some defect in the 20-inch gauge, leading to a leakage outwards, and resulting in a deficient drainage, or some defect in the 40-inch and 60-inch gauges, leading to an increased, and in the case of the 40-inch gauge to an excessive drainage. In regard to these points it should be stated that the only really known leakage was in the 20-inch gauge, already referred to as occurring in February 1879; but this leakage was from the outside inwards, whereas it must be a leakage from the inside outwards that would help to explain the discrepancies in question. The present relatively excessive drainage of the 40-inch gauge is not confined to wet seasons, though it is then greatest, but it appears also in dry years, and even during the spring and summer months. Thus the average drainage from March to August during the last six years was respectively 5·07, 5·68, and 5·18 inches for the three drain-gauges.

On a consideration of all the facts it would seem that the drainage from the 40-inch gauge has been relatively somewhat excessive during the last six years; the excess is however less marked at present than it was two or three years ago. The amount of drainage from the 60-inch gauge has also apparently been in some excess, but in a less degree, during the same period. An *excessive* drainage can clearly only occur by leakage of water from the outside through some defect in the walls. It is evident that from the position of the 40-inch gauge there may be at times a greater pressure of water on two of its sides than there is within the gauge, due to the sloping edges of the walls surrounding the gauges delivering an excessive amount of rain on to the two thin bands of soil which separate the gauges (see Fig. 2), and the thickening of the walls, which took place towards the end of 1874, would increase this side pressure. It must be frankly confessed, however, that it is difficult to believe that leakage would be more marked after the thickening and cementing of the external walls than it was before.

Notwithstanding the difference in the relation of the gauges at different periods of the experiment, it is pretty clear that at all times evaporation has been somewhat greater in a dry season from the soil of the 60-inch gauge than from the soil of the 20-inch gauge, and that consequently capillary attraction has proved capable of bringing water to the surface from a depth exceeding 20 inches. The excess of evaporation on the 60-inch

gauge is, however, at present very small. Thus, during the harvest year beginning September 1, 1879, and ending August 31, 1880, the rainfall was 21·358 inches, the season being the driest corresponding period in the past ten years. The drainage during these twelve months amounted to 6·890 inches from the 20-inch gauge, to 7·393 inches from the 40-inch, and to 6·495 inches from the 60-inch gauge; the excess of evaporation on the 60-inch over that on the 20-inch gauge was thus only 0·395 inch.

(*To be continued.*)

XVIII.—*Mineral Manures and Manuring.* By H. VON LIEBIG, Munich. Translated and abridged by F. J. LLOYD, F.C.S.

THE increased facilities of transport which have arisen of late years, have materially diminished the value of many estates, and a large number of land proprietors have consequently suffered heavy losses. The imposition of protection duties, even supposing they were justifiable, would not have prevented this loss. Many soils, under the new conditions thus brought about, are really not fit for cultivation; nevertheless they have to be cultivated, because the large capital which has already been expended on them cannot be withdrawn. If they consist of light porous soils their possessors have but one means by which to protect themselves from impoverishment. It is by a judicious use of artificial manures. And this is also a *sine quâ non* if we would protect ourselves against the competition of America, Russia, and the Balkans.

The advice is still frequently given to plough an inch deeper in order to bring up new supplies of mineral food to the surface. It is founded on the supposition that the mineral food contained in the soil is inexhaustible and also easily dissolved. But as a matter of fact the subsoil is in 99 cases out of 100 much poorer in assimilable food than the surface soil. The roots of plants cannot make use of the potash in felspar, nor the phosphoric acid in apatite. The carbonic acid in dung and the humus in the soil act far too slowly upon these minerals to dissolve a sufficient quantity of them for abundant crops, and ammonia is too expensive to be used as a solvent; in fact, if farmers had to depend solely upon it there would be no prospect of a better future.

This supposition of the inexhaustibility of the soil has proved a great hindrance to the application of mineral manures, as also has the belief that in order to raise the quality of the

land by such application enormous quantities of manure would have to be employed. Thus Liebig asserted that in order to obtain a good crop from land deficient in phosphoric acid or potash, it was necessary to add to the soil 100 times as much of these substances as is contained in an average crop. This erroneous view rested upon theoretical conclusions, drawn from the natural fertility of soils and the quantity of mineral food they contained. If it were correct it would be impossible to improve profitably the condition of the soil by artificial manuring, or to raise larger crops than those which are the result of its natural fertility. But whilst only small portions of the natural constituents of the soil can be taken up by the roots of plants, nearly everything which is applied as manure can be easily absorbed. For in artificial manuring we use potash in the form of easily soluble salts, such as the sulphate, carbonate, or chloride; and phosphoric acid in the form of guano, bone-meal, or superphosphate.

The fallacy of the supposed necessity of excessive quantities of manure has been demonstrated by experiments. There are soils exceedingly poor in phosphoric acid, which upon the application of a few hundredweights of superphosphate and ammonia-salts, or of guano and common salt, yield tolerably large crops.

Mr. Mechi possessed a soil which had been notorious for its sterility, and which contained, according to Dr. Voelcker's analysis, only 0·04 to 0·06 per cent. of phosphoric acid. By the application of 2 cwt. of Peruvian guano and 1 cwt. of salt he obtained a yield of 6 quarters of wheat per acre.

Mr. Lawes has obtained equally striking results. He has shown how two or three hundredweights of superphosphate and alkalies once applied to the land continue to exert their influence for many years. Two adjacent experimental plots, 10 *a* and 10 *b*, received, the one 420 lbs. potash, 200 lbs. sulphate of magnesia, and 400 lbs. of bone-ash dissolved in 300 lbs. of sulphuric acid, the other double this quantity. From the year 1852 to the year 1865 each plot received 400 lbs. of ammonia-salts annually. On an average, plot 10 *a* yielded 22 bushels of wheat, and plot 10 *b*, $26\frac{1}{4}$ bushels. Thus double the quantity of manure increased the yield by 228 lbs. of wheat per acre per annum, for a period of 12 years. For the next 14 years the increase in yield of plot 10 *b* was 120 lbs. of wheat per annum. Thus the influence of the manure was felt over a period of 26 years.

Whilst these experiments prove not merely the utility, but the necessity, of applying minerals to the soil, they also prove that excessive quantities are not necessary.

The cultivators of poor light soils must make use of a judicious

mixture of phosphates, potash-salts, and dung. Phosphates alone are not sufficient, for light soils are generally deficient in alkalies as well as phosphates. They are frequently too poor in mineral food to make use of even the amount of nitrogen contained in a small dressing of dung. Consequently this nitrogen is lost, being washed out of the soil, in the form of nitrates, by every continuous rainfall.

At one time it was believed that the water contained in the soil was capable of dissolving a sufficient quantity of mineral matter to supply plants with their mineral food, and also that this was the only means by which such mineral food was obtained. Liebig has shown, however, that this is not the case. Plants take up three-fourths of their mineral food directly from the soil itself, by means of the constantly growing and newly formed tips of their rootlets. Voelcker has also shown how small are the quantities of phosphates which pure water dissolves; thus he found that 70,000 lbs. of pure water dissolved of—

	Lbs.
Precipitated phosphate of lime burnt and finely ground	2·20
" " " precipitated and still moist	5·56
" " magnesia burnt and powdered	7·04
" " " precipitated and still moist	14·36
" " lime with 1 per cent. ammonium carbonate	11·28
" " " " 1 " nitrate of soda	6·88
Pure bone-ash from hard bone	1·18
American bone-ash	1·88
Monk's Island phosphate	1·00
Sombrero phosphate	0·84
Coprolites	0·64
Estremadura phosphorite	0·10
Norwegian apatite	0·44
Peruvian guano	2·52

From these figures we learn that the calcium phosphate of Peruvian guano, and of burnt bones, is far less soluble than precipitated phosphate. It is otherwise with bone-meal and steamed bone-meal, of which 5·4 lbs. and 5·9 lbs. respectively were soluble. This is due to the formation of ammonia and organic acids by the decomposition of the gelatine contained in the bones, for these substances facilitate the solution of phosphate of lime. In the same way a small amount of oxalic acid, which exists in guano, increases the solubility of a portion of its phosphate. Ammonia, apart from its stimulating effect upon the growth of the plant, is also a powerful aid to the solution of the phosphates. Hence the influence which bones and guano exert, and when these are used as manures the roots of the plants have not to first seek the phosphoric acid and then the

ammonia, but find both close together. By the use of bone-meal we can give to the plant more absorbable phosphate than with guano, for in guano the entire nitrogen-compounds come into play during the first crop; but in bone-meal the decomposition of the gelatine and the resulting solution of the phosphates proceeds more slowly. Consequently, bone-meal operates upon the after-crop, especially in light soils, so that the total yield obtained by its use may even prove greater than the primarily larger crop yielded from the guano.

When, however, the decomposition of the gelatine in bones is completed, the phosphates which remain undecomposed are less absorbable by the plants than are precipitated phosphates. Consequently the partial solution of steamed bone-meal with half the quantity of sulphuric acid generally employed, or its admixture with superphosphate, is far more rational than its application alone. This is especially true with regard to turnips, and accounts for the rapidly spreading custom of applying dissolved guano to them. In heavy clay soils rich in potash, superphosphates free from nitrogen, such as may be made from Baker Island guano or pure mineral phosphates, frequently give a better yield of turnips than guano and bone-meal. The considerable proportion of potash in these soils facilitates the action of the phosphates. The influence of the superphosphate is not due to the absorption by the plant of a dilute solution of superphosphate, but to the changes which take place in the soil.

The action of the soil upon superphosphate and the changes which the latter undergoes therein were first shown by Voelcker in 1863, and his exhaustive experiments practically brought the question to a conclusion. Like all his experiments, though essentially scientific, they show his thorough comprehension of their practical bearing, and thus enable not merely theoretical but practical results to be drawn from them.

Simultaneously with the actual solution of the superphosphate in the water of the soil, its phosphoric acid becomes again precipitated upon the particles of lime, alumina, and oxide of iron which surround it. Thus it becomes infinitely divided in the form of an impalpable powder, compared with which the finest powder obtainable by mechanical means is like a coarse meal.

Every kind of soil, without exception, is capable of precipitating the phosphoric acid from a solution of superphosphate within 24 hours.

This was proved by Dr. Voelcker by the following experiments:—

To 12 oz. of soil were added 109·24 grains of superphosphate

(containing 40·6 grains soluble phosphate) dissolved in 1½ pint of water.

	Containing—		In 24 hours precipitated of the Dissolved Phosphates.
			Grains.
A red loamy soil	Oxides of iron and alumina .. Carbonate of lime	6·10 1·22	24·29
A calcareous soil	Oxides of iron and alumina .. Carbonate of lime	7·54 67·50	31·40
A stiff clay subsoil	Oxides of iron and alumina .. Carbonate of lime	17·38 1·02	19·30
A stiff clay surface soil ..	Oxides of iron and alumina .. Carbonate of lime	7·85 2·08	20·70
A light sand soil	Oxides of iron and alumina .. Carbonate of lime	12·16 0·15	21·46

Professor Nessler made like experiments with a loamy soil containing 18 per cent. of lime, but used 3·4 times as much superphosphate as Voelcker; nevertheless he obtained similar results.

Thus it has been clearly demonstrated that the value of superphosphate as a phosphatic manure does not depend upon the solubility of the phosphoric acid, but upon the greater division of the insoluble phosphates which are produced from it by precipitation in the soil. The precipitates so formed are compounds which the roots of plants can easily absorb or at least decompose. This latter action must take place with the precipitates of iron and alumina, for although iron has some application in the economy of plants, alumina is only found in a few exceptional families. That the precipitates of iron can be decomposed by the roots of plants has been directly proved by Dr. Peterson, both by means of water-culture and by field-experiments.

The above experiments of Voelcker and Nessler show that 1000 lbs. of earth can precipitate from 2 to 9 lbs. of superphosphate. A high manuring, therefore, of from 4 to 5 cwts. of rich superphosphate per acre, would cause the phosphoric acid to be precipitated like a galvanic coating on the particles of lime, alumina, and oxide of iron of the surface soil, to a depth of from 4 to 9 inches.

The diffusion and solution of phosphoric acid by means of the water in the soil are extraordinarily slight. My analyses of the surface and subsoils of experimental plots at Rothamsted, which plots had received yearly for 22 years 3½ cwts. of super-

phosphate per acre, showed that three-fourths of the phosphoric acid remained within the first 9 inches of surface-soil, and one-fourth in the next 9 inches. In the third 9 inches no appreciable quantity above that naturally present in the soil could be found, save on those plots which had received at the same time 1000 lbs. of potassium and sodium-salts.

Hence it follows that the action of superphosphate, especially during the first year, depends not merely on the quantity applied, but also on the care with which it is distributed in the soil. Only by mechanical aids, such as the harrow, can we bring the phosphoric acid of superphosphate a few inches deeper into the soil, or somewhat deeper still by means of the plough. And these are the only means by which we can assist in distributing the phosphates and potash-salts applied to the soil. A more thorough division and distribution may, however, be obtained if the superphosphate before being applied is dissolved in water. Professor Voelcker quotes an experiment in support of this. Two hundredweights of superphosphate per acre dissolved in water before being applied to the land gave the same result of turnips as 4 cwts. strewn broadcast over the ground and harrowed in. In the latter case much of the superphosphate remained unchanged upon the surface until dissolved by heavy rain. Not until then was the phosphoric acid precipitated by the surrounding soil. Even after six weeks, particles of superphosphate were found still acid and consequently unchanged. This explains the feeble action which superphosphate sometimes exhibits in dry weather.

The reason why we dissolve all phosphates, even bone-meal, in acid, is not that they may become more soluble in water and remain so, but that by subsequent precipitation they may be brought, firstly, into a finer state of division than can be obtained by any mechanical means; and secondly, because when in this state they are easily acted upon by organic acids. Freshly precipitated tribasic calcic phosphate is easily soluble in acetic acid, just as the dibasic phosphate is soluble in ammonium citrate; but bone-ash and bone-meal are no more attacked by these reagents than mineral phosphate is. Many practical and experienced agricultural chemists, therefore, consider that the so-called reverted phosphates, which occur in superphosphates made from phosphorite, as well as all other precipitated phosphates soluble in ammonium citrate, may be just as valuable to the farmer as soluble phosphate.

Coarse bone-meal and bones were employed as manure in large quantities before 1843, but it was at that time believed that gelatine and lime were the fertilising portions. Liebig first pointed out that phosphoric acid was the most valuable con-

stituent of bones; and in accordance with his mineral theory, which is still greatly misunderstood, he advised that the bones should be dissolved with sulphuric acid. The preparation of superphosphate, which was thus based upon purely theoretical principles, has stood the test of experience. The manufacture of artificial manures at the present day consists almost exclusively in the preparation of superphosphate, and is an important industry in nearly every civilised country.

This advice of Liebig's caused Mr. Lawes to commence experiments on superphosphates, which he has continued up to the present day. It may without hesitation be said that these experiments at Rothamsted have done more towards the practical solution of the mineral theory, and the promotion of a rational system of manuring, than has been done at any other experimental station. Although the quantities of manure which have been used are neither economical nor practical, yet, so numerous and varied are the experiments that they supply a clear practical answer to almost every question. Were it not for these experiments of Messrs. Lawes and Gilbert we should at the present day merely know that crops were benefited by the addition of superphosphate and potash, either separately or together, whether with or without ammonia. As to what are the conditions under which this improvement takes place, what crops are most benefited, and how the individual factors act in a long series of years—on all these points we should still know nothing.

Upon the discovery and opening of the rich potash-beds in Germany, Liebig pointed out the necessity of adding potash to manures. Its use was unprofitable 30 years ago because it was not then an article of commerce, and subsequently when employed it became unprofitable because it was applied in excessive and irrational quantities. If employed in limited quantities, it will be no longer unremunerative, but as profitable and as necessary for the cultivation of light soils as is superphosphate. Even where phosphates alone operate, their action is generally augmented by the addition of potash-salts, because the amount of potash naturally in the soil is not sufficient to bring the whole of the phosphates into operation.

A series of experiments, conducted at Rothamsted, shows how great is the action of potash combined with phosphates upon permanent pasture, even on a heavy soil.

These experiments are not all that could be desired, because only for the last two years do we know the total produce of the plots. We may, however, draw definite conclusions from the preceding years, when the hay-harvest alone was gathered in, and the aftermath eaten off, if we suppose the aftermath to be equal to half the yield of hay.

The quantities of manure employed were much greater than was necessary, and such as could not be made to pay in practice, and it is evident that the soil possessed too small an amount of assimilable mineral food to bring the whole of the added nitrogen into operation.

Plot.	Mean of the Years 1856–78. Yield per Acre. Hay alone.		Mean of Years 1877–78.	
	First 10 years.	2nd 10 years.	Hay alone.	Hay and aftermath.
	Cwts.	Cwts.	Cwts.	Cwts.
No. 3. Unmanured	$22\frac{1}{2}$	20	$18\frac{3}{4}$	$28\frac{7}{8}$
„ 4. 1. Superphosphate	$23\frac{1}{4}$	$21\frac{1}{4}$	$23\frac{7}{8}$	$42\frac{7}{8}$
„ 4. 2. „ & ammonia	$33\frac{7}{8}$	$30\frac{1}{2}$	$37\frac{1}{4}$	$54\frac{7}{8}$
„ 9. Superphosphate, alkalies and magnesia, and ammonia	$53\frac{5}{8}$	$48\frac{1}{2}$	55	$78\frac{1}{8}$
„ 5. Ammonia alone (about 400 lbs. Ammonia salts)	$30\frac{1}{2}$	22	$21\frac{3}{4}$	41
„ 18. First 10 years unmanured, 2nd 10 years received the ash constituents including nitrogen of 1 ton of hay	21	$33\frac{1}{4}$	$37\frac{3}{8}$	$55\frac{3}{8}$

Superphosphate alone raised the crop 8 cwts.; combined with 400 lbs. of ammonia-salts it increased it by 20 cwts., and upon the addition of alkalies the increase in yield rose to 44 cwts. Thus the addition of alkalies more than doubled the increase in yield obtained by superphosphate and ammonia alone. Who then can logically attribute to potash as a means of increasing the crops a lower value than to phosphoric acid. It is only the arbitrary and excessive quantities which are generally employed that make it unprofitable: even superphosphate would be unprofitable if we had to employ excessive quantities annually in order to obtain a continuous action.

The strict deduction of Liebig's mineral theory is that a regular return to the soil of the minerals and nitrogen yearly taken out of it is sufficient to maintain its fertility. The results on plot No. 18 give a most positive practical proof of the truth of this doctrine of restitution. Reckoning as above, the unmanured field yielded 31 cwts. of hay and aftermath. For 12 years the plot to which each year the mineral matter and nitrogen of 20 cwts. of hay was applied yielded annually $55\frac{3}{4}$ cwts. The addition, therefore, of the mineral constituents,

together with the nitrogen of 20 cwts. of hay, caused an increase of 24 cwts. of hay and aftermath over the unmanured plot.

The use of dung as a source of nitrogen is unfavourable. For every 1 cwt. of hay, only 1½ lb. of nitrogen are needed as ammonia-salts, whilst 3·5 lbs. of nitrogen are required in the form of dung. In other words, upon pasture-land we use up the nitrogen in dung very imperfectly; scarcely half of it comes into operation. This agrees with practical experience, which teaches us that dung is far more profitably applied to arable land than to pasture. Even in arable land for cereals, and still more so for turnips, the nitrogen of dung is never completely utilised. This is owing not merely to a deficiency of phosphates, but in most cases just as much to a want of potash. Simultaneously with the use of dung, phosphates and potash should also be applied. The potash and phosphoric acid mutually make each other available, and both combined bring into play the full activity of the nitrogen. The amount of nitrogen in the dung and soil is really sufficient for larger crops, but the quantity of available mineral salts in the dung and the soil is not sufficient. Hence, the better the dung,—the greater the care which has been bestowed on its management—the less favourable is its utilisation, and consequently the more costly becomes its production. We cannot, therefore, say that rich dung is preferable to poor.*

Liebig, in his 'Natural Laws of Husbandry,' which work is unfortunately little read, and even less understood, has shown that the exclusive use of dung without the aid of mineral manures must condemn the cultivators of medium and poor soils to continuous poverty. In support of this he quotes some experiments made in Saxony by Dr. Reuning. Upon soils in Kunersdorf, Mäusegast and Kötiz 1 cwt. of dung raised the yield of corn 15·3, 10·7 and 9·8 lbs. respectively above the yield of the unmanured plot. Upon poorer soils in Oberbobritzsch and Oberschönau the increase in yield was only 5·1 and 5 lbs. Hence the good soil realised from the same quantity of dung two or three times as much as the bad. On the other hand, an addition of 100 lbs. of bone-meal gave an increased yield over the unmanured plot in Kunersdorf of 280 lbs., in Kötiz of 40 lbs., and in Oberbobritzsch of 19 lbs. of wheat. The poorer soil in Oberbobritzsch, therefore, produced from the same quantity of phosphoric acid and nitrogen nearly five times as much as the naturally richer field in Kötiz. Hence we conclude that the large excess of nitrogen in the dung could not be utilised in

* The views expressed in this paragraph respecting the use of dung are contrary to those generally accepted by agricultural authorities in England. —F. J. L.

Oberbobritzsch nor in Mäusegast, because the small amount of available phosphoric acid necessary for the plant roots was not present in the soil. It is evident that with such poor soils the yield can only be permanently raised by the application of mineral manures, and that the addition of nitrogenous manures is a matter of secondary consideration.

Professor Voelcker has frequently proved that when superphosphate had no action on turnips, it was invariably due to deficiency of potash in the soil. If, therefore, superphosphate or bone-meal did not increase the yield on a poor soil it is no proof that the soil was not deficient in phosphoric acid. Similarly, if a clay soil, rich in potash and not wanting in phosphoric acid, yields clover-crops inferior to those of a calcareous loam actually poorer in potash and phosphoric acid, it is evident that an addition of these substances to the former soil will give no profitable return. In such a case the application of caustic lime will be in harmony with theory and practice. Thus, on the sugar-beet soils of Bohemia and Moravia, which are rich in potash, the application of a potash manure is without action, whilst the application of caustic lime improves both the quality and quantity of the roots.

It is incorrect to apply potash-salts, without applying phosphate at the same time, to sandy soils deficient in potash. Neither, by itself, would prove profitable, but together they will cause a lasting increase in the crops. Again, where superphosphate or bone-meal together with dung immediately causes an increase in the wheat-crop, there will be a falling-off in the clover and turnip-crops unless potash be added.

We have thus endeavoured to show that the proprietors of poor kinds of land can only hope to increase their rents and thereby partially compensate for the depreciation of their estates by the judicious use of artificial manures.

XIX.—*Annual Report of the Consulting Botanist for* 1880.

By W. Carruthers, F.R.S.

A larger number of the seeds of grasses and other cultivated plants have been submitted for investigation as to their germinating qualities and freedom from impurity than during any previous year. Somewhat over 100 samples have been examined. On the whole these seeds have been more satisfactory than those of previous years. I still find the seeds of *Alopecurus pratensis* are gathered unripe, and that a very small

percentage—sometimes only one or two—of the seeds are able to germinate. The great bulk of the samples consist of only the empty glumes.

I have supplied several members with notes on the nature of different weeds, and recommendations of how to deal with them. In several localities the common spurry (*Spergula arvensis*) has been exceptionally troublesome—a weed which is extremely difficult to extirpate, on account of the number and vitality of the seeds, which are so readily and abundantly produced.

I have informed members of the Society of the nature of the moulds and other parasitic fungi which attack wheat and other crops, and of the methods for treating them, with the view of destroying them or arresting their progress.

Several cases of the stoppage of drains and pipes, through the entrance of roots in search of water, have been dealt with. I made an investigation of the weeds growing in the Costa, in Yorkshire, and reported on their nature, and suggested methods for their extirpation.

During the past year few insect plagues have been brought under my notice. In some districts the *Tipula* grub was again abundant. I had sent to me specimens of purple ears, which were exceptionally abundant in the wheat crop of one locality. This condition of the ear is produced by a minute worm, generally known as *vibrio*. I strongly urged the destruction by fire of the diseased grains, as the *vibrios* have a remarkable tenacity of life. If they were introduced into a field with the seed-corn they would certainly cause injury to the succeeding crops.

The action of the various steeps employed to clean seed-corn from the spores of smut and other fungi has engaged my attention. Some of the earlier steeps were efficacious merely because they floated the light spores, which could then easily be skimmed from the surface of the fluid. The use of a solution of sulphate of copper, which has become so common, was efficacious, because it destroyed the spores. Some caution is required in its application, so as to prevent the seed being itself destroyed, either through too long exposure to the action of a weak solution, or to the shorter but more violent action of a stronger solution. Indeed, from a series of experiments instituted by Prof. Buckman, he came to the conclusion that the beneficial action of steeps was not due to their destroying the spores of the fungi, but to their destroying the germinating power of ill-formed and diseased seeds. And he recommended that perfect seed should always be used, and then pickling would be unnecessary ('Journal of the Royal Agricultural Society,' Vol. XVII., p. 175). If

there was need for care in using sulphate of copper and the older steeps, there is much more care necessary with the irritant steeps now largely and successfully employed. My attention was called to this matter by a member of the Society whose wheat had almost entirely failed to germinate, and he rightly attributed this result to the use of a steep in which carbolic acid was a main ingredient. I made several experiments with the particular steep he had employed, and with others; and I found that they were efficient for the destruction of the spores of the fungi, but when they were incautiously applied they were equally destructive to the grain as well. The part of the seed first injured was the radicle of the embryo. This is the least protected part of the embryo, and it is the first part called into active service in the germination of the plant. The action of the irritant steep is to destroy the tender terminal cells of the radicle, and this completely arrests its growth. When the injury is confined to the main radicle, the two lateral radicles which exist in the embryo of the wheat when it leaves the parent plant, take its place, and the initial check in the life of the plant does not produce any permanent injury. In the experiments, I found that even when the greatest care was taken to carry out the application of the steeps as directed by the various proprietors, a certain percentage—not large—of the seeds suffered; and that with the increase of the strength of the solution, or the length of time the seed was exposed to its action, the injury increased, and the embryo was more and more destroyed. In some cases the ascending axis protruded itself, and continued a sickly life while the starch of the seed supplied it with food, but the radicle having been completely destroyed, the plants did not succeed in establishing themselves in the soil. In the case of seeds exposed for twelve hours to a steep of the ordinary strength, every seed was killed. It is consequently impossible to impress too strongly on the farmer to employ these valuable steeps with great caution, and to follow carefully the specified instructions, both as to the strength of the steep and the time which the operation should occupy. It is, however, not desirable to return to the earlier and less dangerous steeps, for the evil properties of these newer steeps are due to the action in a too prolonged or concentrated form of a property which, duly regulated, is very efficacious for the purposes intended.

During the year I visited the growing crops of the wheats competing for the prizes offered by the Society, and the results of these visits, together with the information supplied by the growers, are incorporated in the Report, which appears on pp. 75–86 of this 'Journal.'

XX.—*Annual Report of the Consulting Chemist for* 1880.

CONSIDERING the depressed condition of English Agriculture, I scarcely expected that so large a number of samples as last year, when as many as 1018 were analysed in the Society's Laboratory, would be received for examination in 1880. Contrary to my expectation, however, so far from declining, the number of samples analysed for members of the Society and reported upon has increased 20 per cent., and actually reached in 1880 the large number of 1201. This number exceeds that of the analyses made for members of the Society in the preceding year by 183, and that terminating 1st December, 1878, by 477.

The following return for the last four years shows the continued, and during the last two years rapid, increase of the analytical work done for members of the Royal Agricultural Society.

In 1877	the number of	samples sent for	analysis	amounted to	642
„ 1878	„	„	„	„	724
„ 1879	„	„	„	„	1018
„ 1880	„	„	„	„	1201

In comparison with 1877, nearly twice as many samples were analysed in the Society's Laboratory in 1880.

The large increase, as will be seen by the appended summary, is principally attributable to the many feeding-cakes and meals and artificial manures which were received in 1880. About the same number of guanos were received as in the preceding year, but only 16 samples of nitrate of soda in place of 65 sent in 1879. The reason why comparatively few samples of nitrate of soda were sent was, no doubt, the abnormally high price which nitrate of soda commanded in the manure-market last season, a price which greatly impeded its use for agricultural purposes.

Most of the samples of nitrate were genuine, and fully up to the guaranteed percentage of 95 to 96 of pure nitrate. One sample, however, on examination was found to be nothing more or less than sulphate of soda, or Glauber salt, and contained no nitrate whatever.

As many as 92 waters were analysed by me in 1880, or 40 more than in the preceding year. Amongst them not a few were found totally unfit for drinking purposes, and in two or three cases the injury sustained by horses and cattle could be clearly traced to the foul condition of the water with which they were supplied.

In many rural districts the water-supply, I regret to say, is still very defective.

I beg to direct once more attention to the fact that decorticated cotton-cake, unless broken up much finer than linseed-cake usually is, and given in more moderate proportions, best in conjunction with maize or barley-meal, is liable to do harm to stock. Decorticated cotton-cake contains from 38 to 42 per cent. of albuminous compounds, which is far too large a proportion of nitrogenous constituents in a food to be suitable for herbivorous animals. In consequence of this excess of albuminoids, decorticated cotton-cake, especially if hard pressed and given in coarse bits, is indigestible, and not unfrequently does serious mischief to fattening bullocks or sheep. Young stock kept on poor pasture, and having plenty of exercise, seldom suffer in health, but are greatly benefited by an allowance of 2 to 3 lbs. of decorticated cotton-cake per head of cattle daily, or $\frac{1}{2}$ lb. per head of sheep, whilst at the same time the pasture-land is more improved by the consumption upon it of decorticated cake than by that of linseed- or rape-cake.

During the past season nearly a dozen cases were referred to me in which decorticated cotton-cake proved more or less injurious to cattle and sheep, and was suspected to contain some poisonous ingredient. The examination of the cake, however, showed in every instance the absence of all poisonous or injurious matters, and as the condition of the cake, moreover, was good, fresh, and all that could be desired, I believe no injurious effects would have followed its use, if, in accordance with my oft-repeated recommendations, it had been supplied to the stock broken up fine, in moderate proportions, and mixed with Indian corn or barley, or other meals comparatively poor in nitrogenous and rich in starch and analogous non-nitrogenous constituents.

I would also once more direct attention to the fact that linseed-cakes which are made from anything but clean linseed, still continue to be sold as "pure" or "genuine" linseed-cake. There are, of course, degrees of purity of the seed of which the cake is made, and although the purchaser of cake can hardly expect to obtain the finest quality if he pays 10*s.* or 15*s.* less per ton than the market price of best pure linseed-cake, it is, nevertheless, a reprehensible practice of oilcrushers to brand cake "pure," or to sell cake as genuine linseed-cake, which they know is made from foul or badly screened linseed, often containing a large proportion of small weed-seeds, sand, and dirt.

In the Quarterly Reports during the past season, I have reported several cake-adulteration cases, and alluded to the poisonous character of a linseed-cake in which I found castor-oil beans.

Most of the analyses and reports I have reason to believe have

been of more or less practical utility to the senders of samples, and some present general points of interest to agriculturists justifying a more detailed reference in this Annual Report.

Peruvian Guano.

In last year's annual chemical report reference was made to the practice of unscrupulous manure dealers in selling Peruvian Guano of inferior quality at the top price at which high quality guano is usually sold. This practice does not appear to have been abandoned altogether, as the following two analyses will show, which I made last spring for two members of the Society.

Composition of Two Samples of Peruvian Guano.

	No. 1.	No. 2.
Moisture	17·15	19·16
*Organic matter and salts of ammonia	27·40	22·03
Phosphate of lime	15·08	33·05
†Alkaline salts, &c.	18·27	15·81
Insoluble siliceous matter	22·10	9·95
	100·00	100·00
* Containing nitrogen	6·29	4·49
Equal to ammonia	7·64	5·45
† Containing soluble phosphoric acid	2·69	4·38
Equal to tribasic phosphate of lime	5·87	9·69
Total phosphoric acid	9·60	19·58
Equal to tribasic phosphate of lime	20·96	42·74

Both guanos were sold at 13*l.* 10*s.*, and No. 2 guano was stated to be as good as any imported.

No 1, it will be seen, contained 22 per cent. of useless siliceous matter, and only 7½ per cent. (in round numbers) of ammonia, and 21 per cent of phosphates, whilst No. 2 contained twice as much phosphates, but only 5½ per cent. of ammonia. Both samples were damp and in a bad mechanical condition.

I need hardly say that 13*l.* 10*s.* per ton is an extravagantly high price for guanos which are scarcely worth 10*l.* a ton.

Inferior Artificial Manures.

A good many samples of artificial manures passed through my hands in the course of last year, which were not nearly worth the price at which they were sold. In illustration of cases of that kind I select the following instances:—

Composition of Two Inferior Artificial Manures.

	No. 1.	No. 2.
Moisture	18·20	15·96
*Organic matter	25·76	35·14
Phosphate of lime..	15·43	5·74
Oxide of iron and alumina	10·77	8·71
Sulphate of lime, &c.	21·03	15·35
Insoluble siliceous matter	8·81	19·10
	100·00	100·00
* Containing nitrogen	1·89	1·60
Equal to ammonia	2·20	1·94

No 1 was described by the vendor as being made principally of dissolved bones and fish, "the ammonia being derived from guano with a little sulphate of ammonia, and the potash from sulphate of potash, and dried with fine bone meal, coloured with *calcined* extract of bone containing 5 per cent. of nitrogen." Price 8*l.* per ton. This manure, it will be seen, contained only $2\frac{1}{4}$ per cent. of ammonia, $15\frac{1}{2}$ per cent. of phosphate of lime, and no appreciable amount of potash. 8*l.* a ton, I need hardly say, is a most exorbitant price for a manure like No. 1, for it would be by no means cheap at 4*l.* 10*s.* a ton. No 2 was sold at 5*l.* a ton, although it was scarcely worth half that price.

Advantage of buying Artificial Manures by Analysis.

A member of the Society sent me 7 samples of artificial manures, which, on analysis, showed the following composition :

Composition of Seven Samples of Artificial Manures.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.
Moisture	21·65	22·40	15·35	14·20	12·50	12·15	14·40
*Organic matter ..	19·65	17·95	20·60	19·60	36·13	34·84	15·22
Mono-phosphate	11·06	13·42	10·93	9·51	6·34	10·32	13·16
Tricalcic phosphate	(17·31)	(21·02)	(17·11)	(14·90)	(9·93)	(16·15)	(20 61)
Insol. phosphate ..	9·59	7·94	10·04	11·10	14·25	6·90	12·35
†Calcic sulphate, &c.	31·26	34·45	35·94	36·58	23·48	31·89	39·27
Silica	6·79	3·84	7·14	9·01	7·30	3·90	5·60
	100·00	100·00	100·00	100·00	100·00	100·00	100·00
*Containing N. ..	1·58	·71	·93	·84	3·60	4·58	1·41
Equal to NH_3 ..	1·92	·86	1·13	1·02	4·37	5·56	1·71
†Including nitrate of soda	..	..	..	·30	1·26	2·24	..

These manures were sold at the following prices:

	£ s.	
No. 1	11 10	per ton, as special manure.
„ 2	8 0	„ „ dissolved bones.
„ 3	7 10	„ „ manure for roots.
„ 4	7 0	„ „ turnip manure.
„ 5	8 0	„ „ blood manure.
„ 6	9 10	„ „ corn and grass manure.
„ 7	6 10	„ „ bone manure for turnips.

A reference to the preceding analyses will show:

1. That No. 7 was by far the cheapest manure of the lot, and the best for roots. It contained about the same amount of soluble phosphate, more insoluble phosphate of lime, and nearly 1 per cent. more ammonia than the sample of dissolved bones, No. 2; and although no No. 7 was sold at 30*s.* less per ton than No. 2, it was really worth about 1*l.* more per ton.

2. That the corn and grass manure, No. 6, was a very good manure indeed, and cheap at 9*l.* 10*s.* a ton.

3. It is difficult to understand why the special manure No 1 should have been sold at 11*l.* 10*s.* a ton, whilst a manure like No. 6, worth at least 2*l.* 10*s.* more per ton than No. 1, could be bought at 9*l.* 10*s.* For a manure like No. 1 11*l.* 10*s.* is a ridiculously high price.

4. That the blood manure, No. 5, was a good manure, and not dear at 8*l.*

5. That the turnip manure, No. 4, had about the same money value as the root manure No. 3.

On the whole, Nos. 3 and 4 were sold at fair prices.

Poultry Manure.

Two samples of poultry manure were found to have the following composition:

	No. 1.	No. 2.
Moisture	38·85	43·55
*Organic matter and salts of ammonia	15·01	40·25
Phosphate of lime	2·31	5·37
Carbonate of lime and alkaline salts	4·08	4·18
Insoluble siliceous matter	39·75	6·65
	100·00	100·00
* Containing nitrogen	·89	2·34
Equal to ammonia	1·08	2·84

No. 1 was from a poultry farm. The vendor of No. 1 asked 10*l.* a ton for it, although it was scarcely worth 1*l.* a ton.

No. 2, which came from the henhouse of the gentleman who sent the manure for analysis, was worth about 2*l.* 15*s.* a ton.

Linseed Meal.

When crushed linseed is treated with bi-sulphide of carbon, a good solvent of oils, it can be deprived more perfectly of its oil than by pressure. Linseed-meal, exhausted of most of the oil contained in linseed, of late has become an article of commerce, which appears to be imported into England principally from America.

Two samples of such linseed-meal on analysis showed the following composition:

	No. 1.	No. 2.
Moisture	10·15	11·15
Oil	2·80	2·15
*Albuminous compounds	29·25	30·75
Mucilage, sugar and digestible fibre	39·67	38·43
Woody fibre (cellulose)	11·83	11·07
Mineral matter (ash)	6·30	6·45
	100·00	100·00
* Containing nitrogen	4·68	4·92

From a practical or economical point of view, oil is the most valuable constituent of oil-cakes, and as first-class linseed-cakes contain from $10\frac{1}{2}$ to 12 per cent. of oil, whereas linseed-meal, treated with bi-sulphide of carbon, usually contains under 3 per cent., such meal is not worth as much as good pure linseed-cake.

The samples of meal examined by me during the year were all made from clean linseed; and as the price of the meal is from 30*s.* to 2*l.* lower per ton than linseed-cake, and the meal is very handy for mixing with other food, or for the making of linseed mucilage, it is well worth the attention of rearers and fatteners of stock.

Chinese Pea-cake.

The following is the composition of a sample of Chinese pea-cake lately examined by me:

Moisture	12·79
Oil	7·15
*Albuminous compounds	39·25
Starch, sugar, and digestible fibre	29·60
Woody fibre (cellulose)	5·67
Mineral matter (ash)	5·54
	100·00
* Containing nitrogen	6·28

This cake, which I believe is made from a species of Dolichos bean (*Soja hispida*) cultivated in China and Japan, it will be seen by the preceding analysis is very rich in nitrogenous constituents. It contains a good deal of starch, and about 7 per cent.

of ready-formed oil, and possesses about the same nutritive value as decorticated cotton-cake.

Indian Corn Refuse Meal.

In the manufacture of "corn-flour," a refuse meal is obtained which consists principally of the outer layers of Indian corn, or, so to say, the bran of Indian corn. The meal, I am informed, is well thought of by large farmers in Scotland. Its price per 240 lbs. in Scotland was 11*s.* 6*d.*, Indian meal being sold at 14*s.* to 14*s.* 6*d.* per 240 lbs. The question submitted to me by the sender of the refuse meal was whether it was a cheap feeding-substance at the quoted price.

The analysis of the meal showed the following:—

Composition of Indian Corn Refuse Meal.

Moisture	10·29
Oil	8·83
*Albuminous compounds	15·32
Starch and digestible fibre	56·72
Woody fibre (cellulose)	7·33
Mineral matter (ash)	1·51
	100·00
* Containing nitrogen	2·42

It is interesting to notice that the meal is richer in oil and albuminous compounds than Indian corn. The outer layers of Indian corn, of which the refuse meal mainly consisted, thus appears to be more nutritious than fine corn-flour, and the meal, judging by the preceding analysis, ought to be as good as Indian corn, if not better, for feeding purposes. I consider it a cheap feeding substance.

Rice Press Cake.

In the manufacture of rice-starch a refuse is obtained which, when prepared and dried, constitutes a white-coloured cake, a sample of which lately examined by me had the following composition:

Moisture	10·70
Oil	·40
*Albuminous compounds	14·18
Starch and digestible fibre	65·87
Woody fibre (cellulose)	1·90
†Mineral matter (ash)	6·95
	100·00
* Containing nitrogen	2·27
† Consisting of phosphates	·70
" carbonate of lime	5·75
" silica	·50

I have not been able to learn at what price this cake was sold. It probably was cheap; if so, the meal may be used with advantage for feeding purposes.

Refuse Press-cake from the Manufacture of Grape-sugar.

Another press-cake is produced in the manufacture of glucose and of grape-sugar from Indian corn. A sample of the cake on analysis had the following composition:

Moisture	8·85
Oil	12·75
*Albuminous compounds	25·62
Dextrine, sugar, and digestible fibre	28·01
Woody fibre (cellulose)	9·43
Mineral matter, consisting chiefly of carbonate of lime	15·34
	100·00
* Containing nitrogen	4·10

This cake, it will be seen, contains more oil than good linseed-cake, and about as much albuminous compounds. It is a palatable and nutritious feeding material, and more valuable than rice press-cake.

The 'Journal' of the Society for 1880 contains the following contributions of mine:

1. Report on the Field and Feeding Experiments conducted at Woburn.
2. An Experiment on the Comparative Value of Linseed-cake and a mixture of Decorticated Cotton-cake and Maize-meal for Fattening Bullocks.
3. On the Comparative Value of Soluble and Insoluble Phosphates.
4. On the Composition of Cream and Skim-milk obtained by Laval's Centrifugal Cream-separator.
5. Annual Report for 1879.
6. On a New Method of Testing Milk.
7. On the Composition of Ewes' Milk.
8. On the Composition of Goats' Milk.

In the course of the year I paid fourteen visits to the experimental fields at Crawley Mill Farm. In the spring of the year six additional acres of land were kindly granted by the Duke of Bedford for experimental purposes, to test practically the comparative manuring value of soluble and insoluble phosphates and certain artificial manuring mixtures. The whole of the six acres have grown in this season a crop of swedes on twenty-four plots of a quarter of an acre each, and will go into barley next spring. With a view of ascertaining to what extent the several manures applied to the quarter-acre experimental swede-plots

will benefit the succeeding crops, it is intended to follow the ordinary four-course rotation, and carefully to record the produce of barley, clover, and wheat on the experimental plots for the three following years.

I am preparing a paper for the next 'Journal' on the results of the feeding and manuring experiments obtained at Woburn in 1880.

Analyses made for Members of the Royal Agricultural Society from 1st December 1879 *to 1st December* 1880.

Guanos	80
Fish-guanos	20
Dissolved bones, superphosphates, and compound artificial manures	361
Bone-dust	91
Nitrate of soda	16
Sulphate of ammonia	19
Potash-salts	7
Soot	4
Refuse manures	24
Wool-dust and shoddy	31
Sewage-manures	3
Poultry-manure	3
Manure rape-dust	10
Limestones, chalk, and other minerals	27
Soils	34
Oats, hay, brewer's grains, malt-dust, and other vegetable productions	15
Milks	4
Milk-preservers	4
Feeding-cakes	309
Feeding-meals	35
Cattle-spices	4
Waters	92
Drinks	3
Disinfectants	2
Examinations for poisons	3
Total	1201

XXI.—*Quarterly Reports of the Chemical Committee.*

March 1880.

1. A sample of manure, called British Guano, was sent last May by Mr. W. P. Burbery, The Crofts, Stratford-on-Avon, and on analysis showed the following composition:—

Moisture	16·88
*Organic matter	17·37
Monobasic phosphate of lime	1·62
Equal to tribasic phosphate rendered soluble	(2·51)
Oxide of iron and alumina and a little phosphoric acid	8·71
Sulphate of lime, &c.	34·27
Insoluble siliceous matter (sand)	21·15
	100·00
* Containing nitrogen	·21
Equal to ammonia	·25

This so-called British guano, it will be seen, contained only ¼ per cent. of ammonia and but little phosphate of lime. It was sold by the makers, Messrs. C. F. Jones and Co., 4, New Street, Mark Lane, E.C., at *3l.* per ton on rail at London, and in Dr. Voelcker's judgment is not worth the carriage to any considerable distance. Mr. Burbery wrote as follows:—

"The manure was sold without guarantee. You analysed sample of manure for me the year before. I refused to pay for the manure the year before, as I could find no benefit. Mr. Jones came to see me, and I ultimately agreed to have two tons more and not to pay for the three tons I had used. I settled in that way, as I thought that four tons for *6l.* would be better than paying for the two tons; as I had no guarantee with the manure he could have compelled me to pay."

2. The following is the composition of a sample of an adulterated linseed cake stamped (N), sent by Mr. H. Stephen Allen, Eastover, near Andover:—

Moisture	16·09
Oil	8·46
*Albuminous compounds	25·69
Mucilage, sugar, and digestible fibre	34·78
Woody fibre (cellulose)	9·23
Mineral matter (ash)	5·75
	100·00
* Containing nitrogen	4·11

This cake was poor in oil and adulterated with earth-nut cake.

Mr. Allen wrote :—

"I bought a ton as a sample of an agent. Since receiving your opinion I asked him whether he considered he was selling pure linseed-cake, and he answered in the affirmative. I also wrote to makers asking if it was 'their best make and pure;' they in reply said it was their best make, but made no allusion to the 'pureness.'"

3. Another adulterated linseed-cake, sent by Mr. J. C. H. Robinson, Stevington, Bedford, on analysis gave the following results :—

Moisture	13·41
Oil	7·41
*Albuminous compounds	20·06
Starch, mucilage and digestible fibre	38·95
Woody fibre	11·86
†Mineral matter (ash)	8·31
	100·00
* Containing nitrogen	3·21
† Containing sand and silica	3·95

This cake, it will be seen, was very poor in oil and albuminous compounds. Dr. Voelcker found that it was adulterated with rice-meal, and was made from dirty linseed.

In answer to the usual inquiries, the subjoined letters were received from Mr. Robinson :—

"Stevington, Bedfordshire, Dec. 5th, 1879.

"Sir,—The name of the seller of the cake in question I should not like to give until I have seen him and made him acquainted with your analysis. I bought it last June (I believe that was the month) for pure linseed-cake, to be delivered at Oakley Station in the following November, at 9*l.* 9*s.* per ton, and to be paid for within twenty-eight days after delivery. Cake was much cheaper then than now. The cake is branded "*pure.*" I will write further to-morrow when I have seen the seller.—Yours, &c.

"J. C. H. Robinson.

"A. Voelcker, Esq."

"Linseed-cake Dispute.

"Stevington, January 16th, 1880.

"Sir,—I have pleasure in informing you that this matter is settled by the makers having the cake back and paying me all expenses incurred, also the difference in the value from the time it was bought to the time of delivery.—Yours, &c.

"J. C. H. Robinson.

"Dr. Voelcker."

Mr. Rowland Tayler, M.R.C.V.S., Queen Street, Colchester, on the 8th December, sent a sample of linseed-cake, stating at the same time that he had lost several sheep fed on the cake, and attributed his loss to a poison in the cake.

The subjoined Report shows that the cake was adulterated

with castor-bean cake, and extremely poisonous. No information respecting the vendor and price of this cake could be obtained.

"Laboratory, 12, Hanover Square,
December 19th, 1879.

"DEAR SIR,—I have the pleasure of enclosing an analysis of the sample of cake which you sent to me a short time ago. The cake, I regret to say, is not a genuine linseed-cake, and contains niger-cake and *castor-bean cake*, and in my judgment is rank poison to sheep or cattle. It has a foul smell like that of rotten tea-leaves and similar vegetable substances, and contains dark-coloured bits of vegetable matter, not found in genuine linseed-cake. Unlike good linseed-cake, it does not get nearly as mucilaginous when mixed in a powdered state with water as linseed-cake of fair average quality, and it has a nasty taste and disgusting smell.

"The most serious contamination of the cake is that with castor-cake, the presence of which I have unmistakably verified by repeated microscopical observations. I have also found castor-cake in the meal or powdered cake which accompanied the bits of cake you sent me, and as far as I can judge the powdered cake is of the same character as the unbroken cake. Castor-cake might have been accidentally mixed with linseed-cake in shipping, in which case the powdered cake would contain castor-cake powder, whilst the linseed-cake itself might be free from castor. As the determination of this point is of importance, I examined the meal and the unbroken bits of cake separately, and I find castor-bean husks in the interior of the unbroken pieces of cake; it is clear, therefore, that in the making of the cake castor-beans have been crushed along with the linseed, and that castor-cake did not merely accidentally get mixed up with linseed-cake in the shipping.

"My experience with regard to castor-bean cake is that, whilst castor-oil, as you well know, is a purgative which may be given to man or beast in considerable quantities, the pressed bean-cake is a most virulent irritating poison. A single bean is enough to cause vomiting, purging, and utter prostration, from which the patient does not recover for days. I have, therefore, no hesitation in declaring the cake as very poisonous. Probably less than 1 lb. will cause the death of a sheep.—Believe me, yours faithfully,

"AUG. VOELCKER.

"R. Tayler, Esq."

Dr. Voelcker also directed attention to several samples of oats which had been sent to him for examination, and which he found had been subjected to sulphur-fumes with a view of bleaching or brightening discoloured unsound old oats, and giving them the appearance of sound new oats.

JUNE 1880.

1. A sample of linseed-cake was sent for analysis by Mr. Arthur Paine, Lashbrooke, Henley-on-Thames, who ordered, on the 28th February, 1880, two tons of best linseed-cake. The delivery order described it (inferentially) as their first quality, but it was invoiced simply as linseed-cake, without the qualification "pure," or "best," at 12*l.* a ton, by the manufacturers of the cake.

Mr. Paine wrote to Dr. Voelcker on the 12th of April:—

"I have some linseed-cake which was sent to me for the best linseed-cake; I am very doubtful as to the purity of it."

The following was the composition of the cake:—

Moisture	11·85
Oil	8·50
*Albuminous compounds	28·25
Mucilage, starch, and digestible fibre	27·59
Woody fibre (cellulose)	14·96
†Mineral matter (ash)	8·85
	100·00
* Containing nitrogen	4·36
† Containing sand	3·01

The results of the examination showed that the cake contained earth-nut husks, in addition to crushed linseed; that it was poor in oil, and contained more sand than first-class linseed-cake, and consequently was neither a pure nor a best linseed-cake; and they point to the policy and economy of buyers purchasing only what is guaranteed as pure.

Mr. Paine subsequently wrote:—

"I have often complained to the maker whether the cake was the best or not, and he has always assured me that it was. Since the analysis I have written to the makers and informed them of the result of it; they deny that it could harm cattle."

2. Mr. Charles Middleton, Holkham, Wells, Norfolk, wrote to Dr. Voelcker on the 14th March:—

"Dear Sir,—Will you kindly send me an analysis of cake sent per rail, at your earliest convenience; you will please let me know if it is a pure cake, as it is marked 'pure,' and could you tell me the value for feeding?—Yours truly,

"Chas. Middleton.

"Dr. Voelcker."

The analysis of the cake gave the following results:—

Moisture	11·80
Oil	9·30
*Albuminous compounds	21·62
Mucilage, starch, and digestible fibre	35·65
Woody fibre (cellulose)	12·93
†Mineral matter (ash)	8·70
	100·00
* Containing nitrogen	3·46
† Containing sand	4·25

The cake, which was branded "pure," was poor in oil and albuminous compounds, and contained $4\frac{1}{4}$ per cent. of sand.

The microscopic examination confirmed the analysis, and showed that the cake was made from dirty linseed, containing numerous weed-seeds, and was not a pure linseed-cake.

In reply to the usual inquiries, Mr. Middleton informed Dr. Voelcker that he bought five tons of the cake, at 10*l.* 10*s.* per ton, in January and February, as Norwegian cake, from very respectable dealers, who on being made acquainted with the unfavourable report of the cake, made an allowance of 1*l.* per ton to Mr. Middleton, who does not wish their names published.

Inferior foreign cake offered for sale at a lower price than pure linseed-cake can be sold, should not be branded "pure."

3. Another sample of cake was sent by Mr. J. C. H. Robinson, Stevington, Bedford, who reported having bought it as pure at 11*l.* a ton.

The examination of the cake showed that it was not a pure linseed-cake, but a cake made from dirty linseed, and containing cotton-seed husks.

In answer to the usual inquiries, Mr. Robinson replied:—

"I have to report to you that the cake affair you wrote to me about is now settled. I cannot, as you are aware, give the name of seller, because, as in the previous case, he is a personal friend."

December 1880.

1. Adulterated cakes are sometimes sold as foreign linseed-cakes.

A sample of such a cake, sold as Russian Linseed-cake, had the following composition:—

Moisture	11·98
Oil	9·20
*Albuminous compounds	18·01
Starch, mucilage, and digestible fibre	43·61
Woody fibre (cellulose)	8·46
†Mineral matter (ash)	8·74
	100·00
* Containing nitrogen	2·88
† Containing sand	4·24

This cake, it will be seen, is poor in oil and albuminoids, and made from dirty linseed. It is, moreover, adulterated with rice-meal.

2. Two samples of linseed-cake, sent to me by Mr. Thomas Briggs, Fisherwick, Lichfield, on analysis gave the following results:—

	No. 1.		No. 2.
Moisture	13·65	..	13·40
Oil	10·50	..	10·45
*Albuminous compounds	22·06	..	24·01
Mucilage, starch, and digestible fibre	36·90	..	34·93
Woody fibre (cellulose)	9·39	..	8·81
†Mineral matter (ash)	7·50	..	8·40
	100·00		100·00
*Containing nitrogen	3·53	..	3·84
†Including sand	2·90	..	3·45

These samples were reported by Mr. Briggs to represent two lots of cake; the No. 1 cake was marked "W B pure," and No. 2, "T B pure." The W B pure lot, of one ton, was sold to him by oil-cake merchants as pure linseed-cake at 10*l.* 15*s.* a ton in Hull, less ten per cent. discount for cash in a month. The other was sold by other merchants to him at 9*l.* a ton as T B pure linseed-cake. Neither sample represents a pure linseed-cake. Both contained a good deal of starchy matter, which ought not to be present in pure linseed-cake, and also much more sand than ought to occur in pure linseed-cake.

On receipt of my Report, Mr. Thomas Briggs communicated it to the respective vendors.

The vendors of cake No. 1 appear to have forwarded the Report to the crushers, and in reply sent the purchaser the crushers' answer to themselves, as follows:—

"Dear Sirs,—We are in receipt of your yesterday's letter, with enclosures referring to an analysis of linseed-cake sent by us on your order.

"The cakes sent on the date you give were, so far as we can now judge, of the same quality as we were generally delivering to our orders at that time; if so, they gave satisfaction everywhere else, and we may mention that a large consumer in the neighbourhood, who bought 25 tons shortly before that time, and had a sample of what we sent him analysed by Dr. Voelcker, expressed himself as well satisfied with the result, and showed us the report, which was by no means on all fours with that you now send us. It seems to us, therefore, that though we do not pretend to set up our quality as the highest standard of purity and excellence (which, at the price we charge, would be out of the question), it may have happened that your customer has scarcely done justice in the manner he has selected his sample; or if no complaint can be made on that score, then it must be that the small parcels sent him have, through some temporary carelessness of the workmen, not been manufactured with our usual attention to the details of our trade.

"Do not, however, misunderstand us. We do not venture to set up (as we said before) our ideas as to a standard of purity in linseed-cakes on the same elevated pedestal as Dr. Voelcker. His duty doubtless is to aim at raising the standard all he can; but no one is probably better aware than he that absolute purity is physically and commercially impracticable; and if, therefore, we produce an article which, made of fairly clean linseed, screened over and over again to free it from sand and impurity, and guaranteed free from

any adulteration by us, is not only an extremely cheap article at the price, but an honestly made cake of a reasonably high standard of excellence and purity, we consider we have fully complied with the requirements of those who deal with us. In this sense our cakes are quite what they profess to be. . . ."

The vendors of cake No. 2 replied to him as follows :—

"Dear Sir,—Your favour of the 9th inst. to hand.

"You ordered on the 9th of October two tons T B pure linseed-cakes, and we booked and sent you two tons T B pure at 9*l.* per ton.

"We certainly did not in this case or any other sell these cakes subject to Dr. Voelcker's analysis or approval.

"*We can guarantee them to be made purely from linseed as imported, without the slightest admixture whatsoever by crushers.*

"You well know with ourselves there are various qualities of linseed, and which vary in price as much as 10*s.* or 15*s.* per quarter; this would make a difference in the value of the cakes of about 2*l.* 10*s.* to 3*l.* 15*s.* per ton.

"Now, it will not pay crushers to make cakes from finest *quality of seed obtainable* and sell it at 9*l.* per ton. Is it likely? But nevertheless these cakes were made from *very good quality linseed*, and also without any adulteration on the part of the crushers, as we said before. . . ."

Pure linseed-cake ought to be made from properly-screened linseed, and not from dirty linseed. As far as the consumer of cake is concerned, it matters little to him whether dirt and small weed-seeds are imported with linseed and made into inferior linseed-cake, or whether the imported linseed is adulterated by the crushers. Linseed, genuine as imported, may actually produce a cake which is less valuable than cake made from well-screened linseed and adulterated with 25 per cent. and more of bran or rice-meal. It is not fair of oil-cake merchants to undersell makers of pure linseed-cake made from well-screened linseed, by describing as pure linseed-cakes, oil-cakes which are made from badly-screened or impure linseed, even though the lowness of price should suggest to a purchaser the improbability of purity, nor would the purchaser be legally obliged to accept cakes so sold.

3. A sample of bone-dust, offered for sale as pure bone-dust, on analysis showed the following composition :—

Moisture	9·75
*Organic matter	44·60
Phosphate of lime	37·31
Carbonate of lime	7·84
Sand	·50
	100·00
*Containing nitrogen	2·41
Equal to ammonia	2·92

This bone-dust was largely adulterated with vegetable ivory shavings, a material which has no fertilising value.

4. The same gentleman who sent the adulterated bone-dust also sent a sample of so-called nitrate of soda, which proved to be neither more nor less than crystallised sulphate of soda, or Glauber salts, without a trace of nitrate.

In the two last cases no sales were effected, and in consequence the name of the person who offered the adulterated bone-dust and so-called nitrate of soda is withheld.

ADDITIONS TO THE LIBRARY IN 1880.

I.—PERIODICALS PRESENTED TO THE SOCIETY'S LIBRARY.

Presented by the respective Societies and Editors.

A.—English, American, and Colonial Periodicals.

Agricultural Economist. Vol. XI. 1880.
——— Gazette. 1880.
——— Almanack. 1881.
Agricultural Returns of Great Britain. 1880.
American Agriculturist. Vol. XXXIX. 1880.
Athenæum. 1880.

Bell's Weekly Messenger. 1880.
Bristol Mercury. 1880.

Calcutta. Select Extra-Tropical Plants readily eligible for Industrial Culture or Naturalisation.
Chamber of Agriculture Journal. Vols. XXII. and XXIII. 1880.
Clydesdale Stud Book. Vol. II.
Coates's Herd Book. Vol. XXVI. 1880.
Connecticut Agricultural Experiment Station. Annual Report. 1879.
Country Gentleman's Magazine. 1880.
Country Gentleman. Vol. XVIII. 1880.

Economist. Vol. XXXVIII. 1880.
English Cart-horse Stud Book. Vol. I.
English Herd Book of Jersey Cattle. Vol. I.
Essex Standard. Vol. L. 1880.

Farmer. Vols. XXXIV. and XXXV. 1880.
Farmer's Herald. Vol. XXIX. 1880.
Field. Vols. LIV. and LV. 1880.

Galloway Herd Book. Vol. II. Part III. 1880.
Geological Society, Journal of the. Vol. XXXVI. 1880.

Highland and Agricultural Society of Scotland, Transactions of the. Vol. XII. 1880.

Indian Agriculturist. Vol. V. 1880.
Indiana, State of. First Annual Report of the Depaitment of Statistics and Geology. 1879.
Institution of Civil Engineers, Proceedings ot the. 1880.
——— of Mechanical Engineers, Proceedings of the. 1880.
——— of Surveyors, Transactions of the. Vol. XII. 1880.
Investor's Monthly Manual. Vol. X. 1880.
Irish Farmer's Gazette. Vol. XXXIX. 1880.
Ironmonger. Vol. XXIV. 1880.

Journal of Forestry. Vol. IV. 1880.

Land Agents' Record. Vol. V. 1880.
Live-Stock Journal. Vols. XI. and XII. 1880.
——— ——— Almanac. 1881.

Madras Presidency. Annual Report of the Superintendent of Government Farms. 1879.
Mark Lane Express and Agricultural Journal. Vols. XLIX. and L. 1880.
Massachusetts Agricultural College. Seventeenth Annual Report. 1880.
———, Agriculture of, 1878–80.
Meteorological Society, Quarterly Journal of the. Vol. VI. 1880.
Midland Counties' Herald. Vol. XLIV. 1880.

Nature. Vols. XXI. and XXII. 1880.
Newcastle Courant. 1880.
New South Wales Herd Book. Vols. I. and II.
New South Wales Stud Book. Vol. III.
New Zealand Stud Book of Draught Horses. Vols. I. and II.
North British Agriculturist. Vol. XXXII. 1880.

Ontario School of Agriculture. Fifth Annual Report. 1879.

Prairie Farmer. 1880.

Royal Agricultural College, Cirencester. Report of First Congress, 1880.
Royal Geographical Society, Journal of the. Vol. XLIX.
———, Proceedings of the. 1880.
Royal Institution of Great Britain. Vol. IX. Parts I., II., and III. 1880.
Royal United Service Institution, Journal of the. Vol. XXXIV. 1880.

Smithsonian Institution. Contributions to Knowledge. Vol. XXII. 1880.
———. Miscellaneous Collections. Vols. XVI. and XVII. 1880.
Society of Arts, Journal of the. Vol. XXVIII. 1880.
Springfield, Ill. Ruralist, and Bulletin of the American Berkshire Association. July, 1880.
Statistical Society, Journal of the. Vol. XLIII. Parts I.–IV. 1880.

Tasmania, Statistics of the Colony of. 1880.
Trade and Navigation of the United Kingdom, Accounts relating to the. 1880.

Veterinarian, The. Vol. LIII. 1880.
Veterinary Journal. Vol. XI. 1880.

B. List of Foreign Periodicals.

Berlin. Landwirthschaftliche Jahrbücher. Band VIII. Supplements 1 and 2. 1880.
——. ———————— ————. Band IX. Hefte 1–6. 1880.
——. Journal für Landwirthschaft. 1880. Hefte 1–3.
Brussels. Journal de la Société centrale d'Agriculture de Belgique. 10 Parts. 1880.
Buenos Aires. Anales de la Sociedad Rural Argentina. Vols. XII. and XIII. 1878–79.
Cairo. Bulletin de la Société Égyptienne, 1re Année. Livr. 1, 5, 8. 1880.
Cartagena. Gazeta Agrícola. 10 Parts. 1880.
Geneva. Bulletin du Herd-book de la Suisse Romande. Vol. I. May, 1880.
Heidelberg. Verhandlungen des Naturhistorisch-Medicinischen Vereins. Neue Folge, 2te Band. 5tes Heft. 1880.
Munich. Zeitschrift des Landwirthschaftlichen Vereins in Bayern. 1879.
Oporto. O Agricultor do Norte de Portugal. 8 Parts. 1880.
Paris. Annales Agronomiques. Tome quatrième. Fasc. 1–4. 1880.
——. Revue des Industries Chimiques et Agricoles. Vol. III. No. 32.
——. Journal d'Agriculture Pratique. 1880.
——. Journal de l'Agriculture. 1880.
——. Bulletin de la Société des Agriculteurs de France. 1880.
Rome. Annali di Agricoltura. 5 Parts. 1879. 8 Parts. 1880.
——. Bollettino di Notizie Agrarie. February, 1880.
Strasbourg. Bulletin Trimestriel de la Société des Sciences, &c., de la Basse Alsace. Vols. XIII and XIV. 1879–80.

II.—BOOKS PRESENTED TO THE SOCIETY'S LIBRARY.

Names of Donors in Italics.

A. English, American, and Colonial Books and Pamphlets.

Aveling, T. Steam Road Rolling.
Bagot, Rev. Canon. Report on Continental Butter-making.
Canadian Government. Reports of Tenant Farmers' Delegates on the Dominion of Canada as a Field for Settlement.
Cook, Geo. H. Annual Report of the State Geologist of New Jersey. 1879.
Curtis, Charles E. Estate Management; a Practical Handbook for Landlords, Stewards, and Pupils.
Gilbert, Dr. J. H. Address to the Chemical Section of the British Association.
Greig, John Kinloch. Bank Note and Banking Reform.
Killebrew, J. B. Sheep Husbandry.
Kinch, Edward. Contributions to the Agricultural Chemistry of Japan.
Lawes, J. B., and Dr. J. H. Gilbert. Results of Experiments on the Mixed Herbage of Permanent Meadow. Part I.

McKenzie and Sons, Cork. Gorse, Furze, or Whin: its Cultivation, and Use as Food for Horses, Cattle, and Sheep.
Marsh, Professor O. C. History and Methods of Palæontological Discovery.
Ormerod, Miss E. A. The Cobham Journal.
————————. Notes for Observations of Injurious Insects.
Roth, Henry Ling. Report on the Sugar Industry of Queensland.
Stephenson, Clement. Veterinary Topics of the Day.
Veterinary Department of the Privy Council. Handbook of the Laws and Regulations relating to Contagious and Infectious Diseases among Animals.
Whitehead, Charles. Market Gardening for Farmers.

B. Foreign Books and Pamphlets.

Bruxelles. Labourage à vapeur. Exposé historique et pratique. *J. Pyro*, 1880.
Dorpat. Die Acker-Böden des Krons Gutes Peterhof. *G. Thoms*, 1880.
Königsberg. Die internationale landwirthschaftliche Ausstellung in London, 1879. *Herr Kreiss*, 1880.
Lund. Program för femtonde Allmänna Svenska Landtbruksmötet i Malmö, 1881. 1880. (*Presented by the Swedish Government.*)
Munich. Handbuch des Grossgrundbesitzes in Bayern, 1879. (*Presented by the Agricultural Society of Bavaria.*)
Paris. Danger du sulfure de Carbone. *J.-P. Mazaros*, 1879.
——. Discours sur les irrigations. *J.-A. Barral*, 1880.
——. Enquête sur la situation de l'agriculture en France en 1879. J. A. Barral. 2 Vols. 1879 and 1880. (*Presented by the Société Nationale d'Agriculture de France.*)
Rome. Relazione intorno alle Condizioni dell' Agricoltura in Italia. Vol. IV. 1879. (*Presented by the Italian Minister of Agriculture.*)
Strasbourg. La Distomatose. *A. Zündel*, 1880.
Turin. Canards à bon marché. *G. Ulivi*, 1881.

Royal Agricultural Society of England.

1881.

President.

Mr. WILLIAM WELLS.

Trustees.

Year when Elected.	
1879	H.R.H. The Prince of Wales, K.G., *Marlborough House, Pall Mall,* S.W.
1855	Acland, Sir Thomas Dyke, Bart., M.P., *Sprydoncote, Exeter, Devonshire.*
1857	Bridport, General Viscount, *Cricket St. Thomas, Chard, Somersetshire.*
1850	Chesham, Lord, *Latimer, Chesham, Bucks.*
1861	Dent, J. D., *Ribston Hall, Wetherby, Yorkshire.*
1863	Kingscote, Colonel, M.P., *Kingscote, Wotton-under-Edge, Gloucestershire.*
1868	Lichfield, Earl of, *Shugborough, Staffordshire.*
1854	Macdonald, Sir Archibald Keppel, Bt., *Woolmer Lodge, Liphook, Hants.*
1860	Marlborough, Duke of, K.G., *Blenheim Park, Oxford.*
1839	Portman, Viscount, *Bryanston, Blandford, Dorset.*
1856	Powis, Earl of, *Powis Castle, Welshpool, Montgomeryshire.*
1858	Rutland, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.*

Vice-Presidents.

1873	Bedford, Duke of, K.G., *Woburn Abbey, Bedfordshire.*
1861	Cathcart, Earl, *Thornton-le-Street, Thirsk, Yorkshire.*
1839	Chichester, Earl of, *Stanmer Park, Lewes, Sussex.*
1867	Devonshire, Duke of, K.G., *Holker Hall, Lancashire.*
1847	Eversley, Viscount, *Heckfield Place, Winchfield, Hants.*
1848	Gibbs, Sir Brandreth, 13, *Pelham Crescent, South Kensington,* S.W.
1858	Kerrison, Sir Edward C., Bart., *Brome Hall, Scole, Suffolk.*
1872	Lathom, Earl of, *Lathom Hall, Ormskirk, Lancashire.*
1848	Lawes, John Bennet, *Rothamsted, St. Albans, Herts.*
1852	Richmond and Gordon, Duke of, K.G., *Goodwood, Chichester, Sussex.*
1859	Vernon, Lord, *Sudbury Hall, Derby.*
1855	Wynn, Sir Watkin Williams, Bart., M.P., *Wynnstay, Ruabon, Denbighshire.*

Other Members of Council.

1858	Amos, Charles Edwards, 5, *Cedars Road, Clapham Common, Surrey.*
1877	Arkwright, J. H., *Hampton Court, Leominster, Herefordshire.*
1880	Ashworth, Alfred, *Poynton, Cheshire.*
1875	Aveling, Thomas, *Rochester, Kent.*
1875	Aylmer, Hugh, *West Dereham, Stoke Ferry, Norfolk.*
1863	Bowly, Edward, *Siddington House, Cirencester, Gloucestershire.*
1880	Carrington, W. T., *Croxden Abbey, Uttoxeter, Staffordshire.*
1874	Chandos-Pole-Gell, H., *Hopton Hall, Wirksworth, Derbyshire.*
1878	Davies, David Reynolds, *Agden Hall, Lymm, Cheshire.*
1860	Druce, Joseph, *Eynsham, Oxford.*
1871	Egerton, Hon. Wilbraham, M.P., *Rostherne Manor, Knutsford, Cheshire.*
1873	Evans, John, *Uffington, Shrewsbury, Salop.*
1876	Feversham, Earl of, *Duncombe Park, Helmsley, Yorkshire.*

Year when Elected.	
1879	FOSTER, S. P., *Killhow, Carlisle, Cumberland.*
1875	FRANKISH, WILLIAM, *Limber Magna, Ulceby, Lincolnshire*
1879	GORRINGE, HUGH, *Kingston-by-Sea, Shoreham, Sussex.*
1874	HEMSLEY, JOHN, *Shelton, Newark, Notts.*
1876	HOWARD, CHARLES, *Biddenham, Bedford.*
1878	HOWARD, JAMES, M.P., *Clapham Park, Bedfordshire.*
1871	JONES, J. BOWEN, *Ensdon House, Montford Bridge, R.S.O., Salop.*
1869	LEEDS, ROBERT, *Keswick Old Hall, Norwich.*
1872	LEICESTER, Earl of, K.G., *Holkham Hall, Wells, Norfolk.*
1874	LINDSAY, Colonel LOYD, M.P., *Lockinge Park, Wantage, Berkshire.*
1865	LOPES, Sir MASSEY, Bart., M.P., *Maristow, Roborough, Devon.*
1871	McINTOSH, DAVID, *Havering Park, Romford, Essex.*
1874	MARTIN, JOSEPH, *Highfield House, Littleport, Isle of Ely, Cambridgeshire.*
1880	MORETON, Lord, M.P., *Tortworth Court, Falfield, R.S.O., Gloucestershire.*
1879	NEVILLE, ROBERT, *Butleigh Court, Glastonbury, Somersetshire.*
1857	PAIN, THOMAS, *Audleys Wood, Basingstoke, Hants.*
1861	RANDELL, CHARLES, *Chadbury, Evesham, Worcestershire.*
1875	RANSOME, ROBERT CHARLES, *Ipswich, Suffolk.*
1867	RAVENSWORTH, Earl of, *Ravensworth Castle, Durham.*
1871	RAWLENCE, JAMES, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	RIDLEY, Sir M. WHITE, Bart., M.P., *Blagdon, Cramlington, Northumberland.*
1875	RUSSELL, ROBERT, *Horton Court Lodge, Dartford.*
1874	SANDAY, GEORGE HENRY, *Wensley House, Bedale, Yorkshire.*
1878	SHERATON, WILLIAM, *Broom House, Ellesmere, Salop.*
1856	SHUTTLEWORTH, JOSEPH, *Hartsholme Hall, Lincoln.*
1874	SPENCER, Earl, K.G., *Althorpe, Northampton.*
1875	STRATTON, RICHARD, *The Duffryn, Newport, Monmouthshire.*
1874	TURBERVILL, Lieut.-Col. PICTON, *Ewenny Priory, Bridgend, South Wales.*
1845	TURNER, GEORGE, *Great Bowley, Tiverton, Devonshire.*
1871	TURNER, JABEZ, *Norman Cross, Yaxley, Huntingdonshire.*
1871	WAKEFIELD, WILLIAM H., *Sedgwick, Kendal, Westmoreland.*
1870	WELBY-GREGORY, Sir WILLIAM EARLE, Bart., M.P., *Denton Hall, Grantham, Lincolnshire.*
1870	WHITEHEAD, CHARLES, *Barming House, Maidstone, Kent.*
1865	WILSON, JACOB, *Woodhorn Manor, Morpeth, Northumberland.*
1878	WISE, GEORGE, *Woodcote, Warwick.*

Secretary and Editor.

H. M. JENKINS, 12, *Hanover Square, London*, W.

Consulting Chemist—Dr. AUGUSTUS VOELCKER, F.R.S., 12, *Hanover Square*, W.

Consulting Botanist—W. CARRUTHERS, F.R.S., F.L.S., *British Museum*, W.C.

Consulting Veterinary Surgeon—Professor JAMES BEART SIMONDS, *Royal Veterinary College, Camden Town*, N.W.

Veterinary Inspectors—THE OFFICERS OF THE ROYAL VETERINARY COLLEGE.

Consulting Engineers—EASTONS & ANDERSON, 3, *Whitehall Place*, S.W.

Consulting Surveyor—GEORGE HUNT, *Evesham, Worcestershire.*

Seedsmen—THOMAS GIBBS and Co., *Corner of Halfmoon Street, Piccadilly*, W.

Publisher—JOHN MURRAY, 50, *Albemarle Street*, W.

Bankers—THE LONDON AND WESTMINSTER BANK, *St. James's Square Branch*, S.W.

STANDING COMMITTEES FOR 1881.

Finance Committee.

Kingscote, Colonel (Chairman).
Bridport, General Viscount.
Ridley, Sir M. White, Bt.
Davies, D. R.
Frankish, W.
Randell, Charles.
Shuttleworth, J.

House Committee.

The President.
Chairman of Finance Committee.
Bridport, General Viscount.
Gibbs, Sir Brandreth.
Cantrell, C. S.
Kingscote, Colonel.

Journal Committee.

Dent, J. D. (Chairman).
Cathcart, Earl.
Ridley, Sir M. White, Bt.
Chandos-Pole-Gell, H.
Frankish, W.
Hemsley, J.
Howard, J.
Jones, J. Bowen.
Kingscote, Colonel.
Ransome, R. C.
Turbervill, Lieut.-Col.
Wells, W.
Whitehead, Charles.
Wise, G.

Chemical Committee.

Macdonald, Sir A. K., Bart. (Chairman).
Bedford, Duke of.
Vernon, Lord.
Arkwright, J. H.
Aveling, T.
Carruthers, W.
Davies, D. R.
Dent, J. D.
Howard, C.
Jones, J. Bowen.
Lawes, J. B.
Neville, R.
Turbervill, Lieut.-Col.
Voelcker, Dr. A.
Wakefield, W. H.
Warren, R. A.
Wells, William.
Whitehead, Charles.

Seeds and Plant-Diseases Committee.

Whitehead, Charles (Chairman).
Vernon, Lord.
Gibbs, Sir Brandreth.
Ashworth, A.
Carruthers, W.
Frankish, W.
Jones, J. Bowen.
Turbervill, Lieut.-Col.
Voelcker, Dr.

Veterinary Committee.

Egerton, Hon. Wilbraham (Chairman).
Bridport, General Viscount.
Ridley, Sir M. White, Bt.
Gibbs, Sir Brandreth.
Ashworth, A.
Brown, Professor.
Chandos-Pole-Gell, H.
Davies, D. R.
Duguid, W.
Fleming, George.
Foster, S. P.
Gorringe, H.
Greenfield, Dr. Wm. Smith.
Harpley, M. J.
Kingscote, Colonel.
Lindsay, Colonel Loyd.
Sanday, G. H.
Sanderson, Dr. J. Burdon.
Simonds, Professor.
Stratton, R.
Wakefield, W. H.
Wilson, Jacob.

Stock-Prizes Committee.

Chandos Pole-Gell, H. (Chairman).
Bridport, Gen. Visct.
Gibbs, Sir Brandreth.
Arkwright, J. H.
Ashworth, A.
Aylmer, H.
Bowly, Edward.
Davies, D. R.
Evans, John.
Frankish, W.
Gorringe, H.
Hemsley, J.
Howard, C.
McIntosh, D.
Pain, T.
Randell, C.
Sanday, G. H.
Sheraton, W.
Simonds, Prof.
Stratton, R.
Turner, Geo.
Wakefield, W. H.
Wilson, Jacob.
Wise, G.
The Stewards of Live Stock.

Implement Committee.

Bridport, Gen. Viscount.
Vernon, Lord.
Gibbs, Sir Brandreth.
Anderson, W.
Aveling, T.
Carrington, W. T.
Frankish, W.
Gorringe, H.
Hemsley, J.
Howard, C.
Howard, J.
Jones, J. Bowen.
Martin, J.
Neville, R.
Ransome, R. C.
Rich, W. E.
Sanday, G. H.
Sheraton, W.
Shuttleworth, Joseph.
Stratton, R.
Turbervill, Lieut.-Col.
Turner, Jabez.
Wilson, Jacob.
The Stewards of Implements.

General Derby Committee.

Bedford, Duke of, (Chairman).
Bridport, Gen. Viscount.
Cathcart, Earl.
Moreton, Lord.
Vernon, Lord.
Ridley, Sir M. W.
Egerton, Hon. W.
Gibbs, Sir Brandreth.
Ashworth, A.
Aveling, T.
Aylmer, H.
Cantrell, Charles S.
Carrington, W. T.
Chandos-Pole-Gell, H.
Coke, Hon. E.
Coleman, J.
Corbett, Geo.
Davies, D. R.
Dent, J. D.
Foster, S. P.
Frankish, W.
Gorringe, H.
Hemsley, J.
Hobson, Alderman.
Howard, C.
Jones, J. Bowen.
Kingscote, Colonel.
Mayor of Derby.
Murray, G.
Neville, R.
Randell, Charles.
Sanday, G. H.
Sheraton, W.
Shuttleworth, J.
Smith, Alderman J.
Troutbeck, G.
Turbervill, Lieut.-Col.
Turner, Alderman.
Wade, S.
Wakefield, W. H.
Whitehead, C.
Wilson, Jacob.
Wise, Geo.

Show-Yard Contracts Committee.

Shuttleworth, Joseph (Chairman).
Gibbs, Sir Brandreth.
Amos, C. E.
Aveling, T.
Chandos-Pole-Gell, H.
Frankish, W.
Hemsley, J.
Howard, C.
Randell, Charles.
Sanday, G. H.
Stratton, R.
Wilson, Jacob.

Committee of Selection.

Cathcart, Earl.
Bridport, Gen. Viscount.
Ridley, Sir M. W.
Frankish, W.
Howard, C.
Turbervill, Lieut.-Col.
Wilson, Jacob.

And the Chairmen of the Standing Committees.

Education Committee.

Bedford, Duke of.
Moreton, Lord.
Aveling, T.
Dent, J. D.
Carrington, W. T.
Carruthers, W.
Kingscote, Colonel.
Jones, J. Bowen.
Kingscote, Colonel.
Turbervill, Lieut.-Col.
Voelcker, Dr.
Wise, Geo.

Cattle Plague Committee.

The whole Council.

*** The President, Trustees, and Vice-Presidents are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Wednesday, December 8th, 1880.

REPORT OF THE COUNCIL.

During the year 1880, the number of Governors and Members has been increased by the election of 6 Governors and 473 Members, and diminished by the death of 2 Governors and 121 Members, the resignation of 92 Members, and the removal of 73 by order of the Council.

The Society now consists of :—

86 Life Governors,
71 Annual Governors,
2724 Life Members,
5181 Annual Members,
20 Honorary Members,

making a total of 8082, and showing an increase of 153 during the year.

The vacancy in the list of Trustees caused by the election of Mr. Wells as President, has been filled by transferring Mr. J. D. Dent from the list of Vice-Presidents, and the Duke of Bedford has been elected a Vice-President to fill the vacancy thus caused. Mr. W. T. Carrington, of Croxden Abbey, Uttoxeter, has been elected a Member of the Council, in the room of the late of Mr. Masfen.

The half-yearly statement of accounts to the 30th June last has been examined and approved by the Society's auditors and

accountants, and has been published for the information of the Members in the last number of the 'Journal.' The funded capital of the Society remains the same as at the last half-yearly meeting, namely, 12,430*l.* 7*s.* New Three per Cents., and the balance of the current account in the hands of the bankers on the 1st inst. was 1188*l.* 16*s.* 1*d.*

The Carlisle Meeting was remarkably successful considering the very unfavourable weather experienced during the three last days. The entries of Live-stock were very large, and the show of Implements was more compact than has been the case for some years. The large attendance of the public in spite of the rain was commonly remarked, as well as the fact that the visitors came principally from the agricultural districts in the neighbourhood. Although the receipts were not sufficient to cover the expenditure, the Council are glad to announce that the deficit will not entail any further diminution of the funded capital of the Society, as it can be covered by the surplus ordinary income of the year.

The offer of medals for new inventions for the cultivation of the land by steam or other mechanical force, did not call forth so much competition as was expected. The trials took place at Harraby during the period of the Carlisle Show, and with their results are described in the last number of the 'Journal' by Mr. Neville, one of the Stewards.

The offer by the Local Committee of Prizes for the best-managed Farms in the Counties of Cumberland and Westmoreland called forth a most interesting and instructive competition; and the Council wish specially to call the attention of the Members of the Society to the full and admirably written Report on it by Mr. H. J. Little, one of the Judges, published in the last number of the 'Journal.'

The preparations for the Derby Meeting next year are well advanced. The Rev. Sir George Wilmot Horton has consented to the Show being held in Osmaston Park, close to the town, and

the Local Committee have already commenced the necessary works of draining and levelling. The Council have deemed it advisable to restrict henceforth the amount offered as Prizes for Live Stock by the Society itself to a maximum of 3000*l.* The Local Committee propose to liberally supplement the Society's Prize-sheet with classes for Agricultural Horses, Hunters, Hackneys, Long-woolled and Shropshire Sheep, Longhorns, Jersey Heifer-calves, and Dairy Cattle, as well as Butter and Cheese.

They have already offered Prizes for the best-managed Farms in the County of Derby and within a radius of twenty miles, and eleven farms have been entered to compete in the three classes of Large Dairy Farms, Small Dairy Farms, and Arable or Mixed Farms.

The Council have added the following Rule to the Stock Prize-sheet:—" No person who has been disqualified from exhibiting live-stock at any Meeting of the Society shall be allowed to act as agent, representative, or servant of an Exhibitor of live-stock at any of the Society's future Shows."

The rule as to shearing has been amended so as to render certain the identity of disqualified sheep, and now stands as follows:—" Inspectors will be appointed by the Council to examine the Sheep on their admission to the Show-yard, with instructions in any cases in which the Sheep have not been really and fairly shorn bare, to mark them and to report the fact to the Stewards."

In consequence of a recommendation made by the Judges of Implements at the Carlisle Show, the Council have decided to organise a competitive trial of Sheaf-binders in connection with the Derby Meeting, and have therefore offered a Gold and a Silver Medal to the Sheaf-binding Machines which, after trial during the harvest of 1881, shall in the opinion of the Judges be the best and the second best,—the binding material to be other than wire.

The Council have decided that the Derby Meeting shall commence on Wednesday, July 13th, and close on the following Monday evening.

The district assigned for the Country Meeting of 1882 comprises Berkshire, Cornwall, Devonshire, Dorsetshire, Hampshire, Kent, Somersetshire, Surrey, Sussex, and Wiltshire.

The experiments upon Anthracoid Diseases, such as Splenic Apoplexy, Quarter-evil, &c., are still being carried out at the Brown Institution. Dr. Greenfield, the Professor-Superintendent of the Institution, has submitted to the Council an Abstract Report stating that the experiments have been entirely successful, and have established the fact that an animal which has been successfully inoculated with modified virus is protected from the effects of future inoculation with the unmodified virus of the disease. The detailed report on these experiments will be published in the next number of the 'Journal;' and having regard to the great importance of the subject the Council have made a grant for the ensuing year for the purpose of enabling this conclusion to be put to practical test.

The Council have had under their consideration the very serious outbreak of Sheep-rot which caused so much mortality amongst the flocks of the country during the past year, and have instituted a practical as well as a scientific investigation into the whole subject. They have also placed within the reach of every one an account of our present knowledge on the subject by the republication of Prof. Simonds's essay on Sheep-rot, and by his paper on the subject in the Spring No. of the 'Journal' of this year.

The Council regret to observe that Foot-and-mouth Disease is again prevalent in several districts, after an almost complete immunity from the disease for nearly two years. With reference to Pleuro-pneumonia, the Council has the satisfaction of reporting that a considerable diminution in the number of cases, as compared with last year, has been effected by the measures

adopted for its extermination. This subject must always command the attention of the Council, and in consequence of representations as to the lax manner in which the importations of Irish cattle are controlled, they have already urged upon the Privy Council that more stringent regulations and more careful inspection of imported Irish cattle are requisite both at the ports of embarkation and arrival. They have further asked the Privy Council to take additional precautions to prevent the spread of Contagious Diseases from the Deptford Cattle-market, as there is reason to believe that Foot-and-mouth Disease has recently been conveyed from there to dairies in the neighbourhood, and thence to other localities in the Metropolitan district.

The six varieties of Seed-wheat that were entered in competition for the prizes of 25*l.* and 10*l.* offered by the Society for distinctly new varieties of wheat were cultivated in the past season in Northumberland, Worcestershire, and Wiltshire, by Mr. Edwards, at Morpeth, Mr. Randell, at Chadbury, and Mr. Rawlence, at Wilton, to whom the Council are much indebted; and also in Bedfordshire on the Society's Experimental Farm at Woburn, under the superintendence of Mr. Malden. The Council, however, have decided that none of the competing varieties fulfilled the conditions required by the Society. The Consulting Botanist inspected each of the plots in the four districts during the summer, and will make a report of the general results of the competition in the forthcoming number of the 'Journal.'

The analytical work for Members of the Society has increased 20 per cent. in 1880, and nearly twice as many samples were analysed in the second year since the opening of the new Laboratory than were sent four years ago.

Experiments on Swedes, to test the comparative manurial value of soluble and insoluble phosphates, have been successfully carried out on twenty-four plots of quarter of an acre each. With a view of ascertaining the after effect of the several

manures, it is proposed to follow the usual four-course rotation on the Experimental Swede-field.

Forty candidates were entered for examination for the Society's Junior Scholarships from the following schools:—Albert Institution, Glasnevin, 1; Bedford County School, 2; Bewdley Grammar School, 2; Devon County School, 2; Norfolk County School, 6; Sandbach Grammar School, 3; Surrey County School, 23; Unattached, 1. The following candidates, arranged in order of merit, have gained Scholarships:—

1.	T. Leese	Sandbach Grammar School.
2.	G. L. Haslehurst	Surrey County School.
3.	E. D. Shirtliff	Surrey County School.
4.	J. H. Hodd	Surrey County School.
5.	F. H. Purchase	Surrey County School.
6.	G. Corbett	Bedford County School.
7.	A. E. King	Surrey County School.
8.	A. F. L. Pattison	Surrey County School.
9.	P. W. Whitcombe	Bewdley Grammar School.
10.	F. H. White	Devon County School.

By order of the Council,

H. M. JENKINS,

Secretary.

MEMORANDA.

ADDRESS OF LETTERS.—The Society's office being situated in the postal district designated by the letter W. Members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

GENERAL MEETING in London, May 23rd, 1881, at 12 o'clock.

ANNUAL EXCURSION to Woburn Experimental Farm, Tuesday, May 24th. For particulars apply to the Secretary previous to May 10th, after which no tickets will be issued.

MEETING at Derby, July 13th and four following days (Sunday excepted), 1881.

GENERAL MEETING in London, December 1881.

MONTHLY COUNCIL (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

ADJOURNMENTS.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

OFFICE HOURS.—10 to 4. On Saturdays, 10 to 2.

DISEASES of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College, Camden Town, N.W.—(A statement of these privileges will be found on page xx. in this Appendix.)

CHEMICAL ANALYSIS.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in this Appendix (page xxi.).

BOTANICAL PRIVILEGES.—The Botanical and Entomological Privileges enjoyed by Members of the Society will be found stated in this Appendix (page xxiv.).

SUBSCRIPTIONS.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £25 for a Governor, and £5 for a Member.

PAYMENTS.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the Office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

NEW MEMBERS.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Royal Agricultural Society of England.

1881.

DISTRIBUTION OF MEMBERS OF THE SOCIETY AND OF MEMBERS OF COUNCIL.

Districts.	Counties.	Number of Members.		Number in Council.		Members of Council.
A.	Bedfordshire ..	120 ..		2		C. Howard; James Howard.
	Buckinghamshire ..	106 ..		1		Lord Chesham, T.
	Cambridgeshire ..	93 ..		1		J. Martin.
	Essex	262 ..		1		D. McIntosh.
	Hertfordshire ..	153 ..		1		J. B. Lawes, V.P.
	Huntingdonshire ..	45 ..		2		Jabez Turner; W. Wells.
	Middlesex	384 ..		1		Sir Brandreth Gibbs, V.P.
	Norfolk	330 ..		4		H.R.H. the Prince of Wales, K.G., T.; Earl of Leicester; Hugh Aylmer; Robert Leeds.
	Oxfordshire	145 ..		2		Duke of Marlborough, T.; J. Druce.
	Suffolk	157 ..		2		Sir E. C. Kerrison, V.P., R. C. Ransome.
			1795		17	
B.	Cumberland	203 ..		1		S. P. Foster.
	Durham	133 ..		1		Earl of Ravensworth.
	Northumberland ..	161 ..		2		Sir M. White Ridley; Jacob Wilson.
	Westmoreland ..	69 ..		1		W. H. Wakefield.
			566		5	
C.	Derbyshire	156 ..		2		Lord Vernon, V.P.; H. Chandos-Pole-Gell.
	Leicestershire ..	101 ..		1		Duke of Rutland, T.
	Lincolnshire	202 ..		3		Sir W. Earle Welby-Gregory; W. Frankish; J. Shuttleworth.
	Northamptonshire	136 ..		1		Earl Spencer.
	Nottinghamshire ..	153 ..		1		J. Hemsley.
	Rutland	16 ..				
			764		8	

DISTRIBUTION OF MEMBERS OF THE SOCIETY—*continued.*

Districts.	Counties.	Number of Members.	Number in Council.	Members of Council.
D.	Berkshire	136 ..	1	Colonel Loyd Lindsay.
	Cornwall	53 ..		
	Devonshire	114 ..	3	Sir T. D. Acland, T.; Sir M. Lopes; G. Turner.
	Dorsetshire	70 ..	1	Viscount Portman, T.
	Hampshire	146 ..	3	Viscount Eversley, V.P.; Sir A. K. Macdonald, T.; T. Pain.
	Kent	399 ..	3	T. Aveling; R. Russell; C. Whitehead.
	Somersetshire ..	157 ..	2	Visct. Bridport, T.; R. Neville.
	Surrey	174 ..	1	C. E. Amos.
	Sussex	171 ..	3	Earl of Chichester, V.P.; Duke of Richmond and Gordon, V.P.; H. Gorringe.
	Wiltshire	111 ..	1	J. Rawlence.
		——1531	— 18	
E.	Yorkshire	382 ..	4	Earl Cathcart, V.P.; Earl of Feversham; J. D. Dent, V.P.; G. H. Sanday.
F.	Gloucestershire ..	233 ..	3	E. Bowly; Lord Moreton; Col. Kingscote, T.
	Herefordshire ..	92 ..	1	J. H. Arkwright.
	Monmouthshire ..	49 ..	1	R. Stratton.
	Shropshire	396 ..	3	John Evans; J. Bowen Jones; W. Sheraton.
	Staffordshire ..	281 ..	2	Earl of Lichfield, T.; W. T. Carrington.
	Warwickshire ..	211 ..	1	George Wise.
	Worcestershire ..	171 ..	1	C. Randell.
	South Wales ..	182 ..	1	Lt.-Col. Picton Turbervill.
		——1615	— 13	
G.	Cheshire	203 ..	3	Hon. W. Egerton; D. R. Davies; A. Ashworth.
	Lancashire	299 ..	2	Duke of Devonshire, V.P.; Earl of Lathom, V.P.
	North Wales ..	207 ..	2	Earl of Powis, T.; Sir W. W. Wynn, V.P.
		—— 709	— 7	
Scotland		113		
Ireland		107		
Channel Islands		10		
Foreign Countries		96		
Members without addresses ..		58		
		—— 384		

ROYAL AGRICULTURAL

Dr. HALF-YEARLY CASH ACCOUNT

	£. s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st July, 1880:—			
Bankers		1,792 18 2	
Secretary		38 2 8	
			1,831 0 10
To Income:—			
Dividends on Stock		181 15 11	
Subscriptions:—			
Governors' Life-Compositions	100 0 0		
Governors' Annual	5 0 0		
Members' Life-Compositions	423 0 0		
Members' Annual	936 19 3		
		1,464 19 3	
Journal:—			
Advertisements	54 2 9		
Sales	106 5 4		
		160 8 1	
Chemical:—			
Laboratory Fees		180 5 0	
Veterinary:—			
Professional Fees		41 19 9	
Establishment:—			
Rent		100 0 0	
Farm Inspection:—			
Entry Fees, 1881		15 0 0	
Sundries		3 18 0	
London Exhibition		155 13 6	
Total Income		.. .. ..	2,303 19 6
			4,135 0 4
To Carlisle Meeting		.. .. ..	12,913 7 11
			£17,048 8 3

BALANCE-SHEET,

LIABILITIES.	£ s. d.	£ s. d.
To Capital:—		
Surplus, 30th June, 1880		19,329 10 0
Less Surplus of Expenditure over Income during the Half-year, viz.:—		
Expenditure	3,315 14 2	
Income	2,303 19 6	
		1,011 14 8
		18,317 15 4
Deduct:—		
Half-year's interest and depreciation on Country Meeting Plant	219 18 4	
Carlisle Meeting:—		
Excess of Expenditure over Receipts	216 8 6	
		436 6 10
		£17,881 8 6

QUILTER, BALL, CROSBIE, GLEGG, & WELTON, *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JULY TO 31ST DECEMBER, 1880. Cr.

	£ s. d.	£ s. d	£ s. d.
By Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	692 10 0		
House:—Rent, Taxes, Repairs, &c.	353 2 2		
Office:—Printing, Postage, Stationery, &c.	277 10 5		
		1,323 2 7	
Journal:—			
Printing and Stitching	586 16 7		
Postage and Delivery	230 0 0		
Literary Contributions	197 5 0		
Woodcuts	9 6 6		
		1,023 8 1	
Chemical:—			
Salaries	383 15 0		
Chemical Apparatus, &c...	61 12 9		
		445 7 9	
Veterinary:—			
The Brown Institution for Investigations, to 31st December, 1880	125 0 0		
Professional Fees to Royal Veterinary College ..	57 2 1		
Fluke Enquiry	100 0 0		
		282 2 1	
Botanical:—			
Consulting Botanist's Salary		50 0 0	
Education:—			
Printing	4 4 0		
Scholarships	140 0 0		
		144 4 0	
Sundries		37 9 8	
London Exhibition		10 0 0	
Total Expenditure		.. .. ..	3,315 14 2
By Carlisle Meeting		11,693 8 9	
Derby Meeting		1,693 2 3	
			13,386 11 0
By Balance in hand, 31st December:—			
Bankers		301 19 2	
Secretary		44 3 11	
			346 3 1
			£17,048 8 3

31ST DECEMBER, 1880.

ASSETS.	£ s. d.	£ s. d.
By Cash in hand	346 3 1	
By New 3 per Cent. Stock 12,430*l*. 7*s*. 0*d*. cost*	11,677 17 1	
By Books and Furniture in Society's House	1,451 17 6	
By Country Meeting Plant	2,712 8 7	
		16,188 6 3
At debit of Derby Meeting	.. .. ..	1,693 2 3
		£17,881 8 6

* *Value at* 98¾ = £12,274 19*s*. 5*d*.

Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 31st December 1880, which at that date amounted to 1414*l*.

Examined, audited, and found correct, this 21st day of February, 1881.

FRANCIS SHERBORN,
A. H. JOHNSON,
HENRY CANTRELL
(pro JOHN TWINCH,)
} *Auditors on behalf of the Society.*

ROYAL AGRICULTURAL

Dr. YEARLY CASH ACCOUNT,

	£. s. d.	£. s. d.	£. s. d.
To Balance in hand, 1st Jan. 1880:—			
Bankers	. .	682 13 4	
Secretary	. .	20 17 4	
			703 10 8
To Income:—			
Interest on Deposit Account	. .	12 1 7	
Subscriptions:—			
Governors' Life Compositions	240 0 0		
Governors' Annual	325 0 0		
Members' Life-Compositions	1,191 0 0		
Members' Annual	4,438 3 3		
		6,194 3 3	
Dividends on Stock	. .	364 7 4	
Journal:—			
Sales	106 5 4		
Advertisements	98 19 11		
		205 5 3	
Sale of 'Hints on Butter-Making'	. .	22 2 9	
Sale of 'Rot in Sheep'	. .	6 0 0	
Chemical:—			
Laboratory Fees	. .	304 0 6	
Veterinary:—			
Professional Fees	. .	51 9 9	
Establishment:—			
Rent	. .	200 0 0	
Farm-Inspection:—			
Entry Fees, 1881	. .	15 0 0	
Sundries	. .	3 18 0	
Total Income	. .	. .	7,378 8 5
To London Exhibition	. .	440 16 10	
Carlisle Meeting	. .	19,454 0 9	
			19,894 17 7
			£27,976 16 8

SOCIETY OF ENGLAND.

FROM 1ST JANUARY TO 31ST DECEMBER, 1880. Cr.

	£. s. d.	£. s. d.	£. s. d.
By Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	1,385 0 0		
House: Rent, Taxes, Repairs, &c.	796 15 3		
Office: Printing, Postage, Stationery, &c.	535 11 1		
		2,717 6 4	
Journal:—			
Printing and Stitching	1,166 14 2		
Postage and Delivery	440 0 0		
Literary Contributions	253 15 0		
Woodcuts	11 1 6		
		1,871 10 8	
Pamphlet on 'Rot in Sheep'	. .	87 12 0	
Chemical:—			
Salaries	761 5 0		
Chemical Apparatus and Chemicals	115 18 9		
Petty Payments	30 0 0		
Fittings, &c.	43 4 4		
		950 8 1	
Veterinary:—			
The Brown Institution for Investigations, 1880	250 0 0		
Prizes and Medals	47 12 0		
Fees to Examiners	21 10 6		
Professional Fees to Royal Veterinary College	57 2 1		
Fluke Enquiry	100 0 0		
		476 4 7	
Botanical:—			
Consulting Botanist's Salary	. .	100 0 0	
Education:—			
Fees to Examiners	52 10 0		
Printing	17 5 0		
Prizes	55 0 0		
Scholarships	220 0 0		
		344 15 0	
Farm Inspection	. .	27 6 10	
Subscriptions (paid in error) returned	. .	2 0 0	
Sundries	. .	41 9 8	
Total Expenditure	. .	. .	6,618 13 2
By London Exhibition	. .	1,049 12 1	
Carlisle Meeting	. .	18,269 6 1	
Derby Meeting	. .	1,693 2 3	
			21,012 0 5
By Balance in hand, 31st Dec. 1880:—			
Bankers	. .	301 19 2	
Secretary	. .	44 3 11	
			346 3 1
			£27,976 16 8

Receipts.

	£.	s.	d.
Subscription from Carlisle	2,000	0	0
Admissions to Show-Yard by Payment	6,852	18	2
Admissions by Season Tickets	617	11	0
Admissions to Stand at Horse Ring	421	8	6
Admissions to Dairy	74	8	0
Sale of Catalogues	471	2	8
Entries in Implement Catalogue	300	0	0
Advertisements in Stock Catalogue	270	10	6
Implement Exhibitors' Payments for Shedding	2,937	4	4
Non-Members' Fees for entry of Implements	152	0	0
Fees for entry of Live-Stock, &c.	726	15	0
Fees for Horse Boxes and Stalls	323	0	0
Premiums for Supply of Refreshments	380	10	3
Premium for Cloak Rooms, Lavatories, &c.	70	0	0
Sale of Fodder	29	0	0
Fines for Non-Exhibition of Live-Stock	95	10	0
Reference Number Fines	4	7	6
Sales of Butter	23	16	2
	£15,750	2	1

To Balance	538	4	10
	£16,288	6	11

ACCOUNT: CARLISLE, 1880.

EXPENDITURE.

	£.	s.	d.	£.	s.	d.
SHOW-YARD WORKS:—						
To Value of Materials transferred from Kilburn	640	13	2			
„ Timber and Joinery	4,179	15	2			
„ Ironmongery	79	1	11			
„ Paints, Oils, and Glass	32	6	6			
„ Canvas	1,304	9	0			
„ Felt, 172*l.* 18*s.*; Oil Baize, 32*l.* 10*s.* 11*d.*	205	8	11			
„ Lime, Bricks, Mortar, and Concrete	42	3	8			
„ Hurdles for Stock Sheds	163	17	1			
„ Coal—Show-Yard, 8*l.* 16*s.* 7*d.*; Trials, 8*l.* 12*s.* 6*d.*	17	9	1			
„ Wages	1,551	16	7			
„ Railway Charges, 494*l.* 4*s.*; Horse Hire, 165*l.* 0*s.* 5*d.*	659	4	5			
„ Postage, Stationery, Telegrams, &c.	50	18	11			
„ Cisterns, 44*l.* 16*s.* 6*d.*; Lavatory Fittings, 14*l.* 0*s.* 10*d.*	58	17	4			
„ Insurance, 20*l.* 12*s.* 6*d.*; Sundries, 2*l.* 10*s.* 8*d.*	23	3	2			
„ Drainage and Tan	6	2	1			
„ Superintendent of Works, 1000*l.*; Surveyor, 252*l.* 5*s.* 6*d.*	1,252	5	6			
„ Depreciation of Plant	454	3	6			
				10,721	16	0
Per Contra:—						
By Auction Sales, 2,963*l.* 12*s.* 11*d.*; Private Sales, 20*l.* 6*s.* 4*d.*	2,983	19	3			
„ Exhibitors and Purveyors	1,073	15	10			
„ Timber and Ironmongery transferred to Derby	741	18	3			
				4,799	13	4
				5,922	2	8
Judges:—Implements, 84*l.*; Stock, 378*l.* 15*s.* 10*d.*				462	15	10
Consulting Engineers and Assistants				145	17	2
Inspectors:—Veterinary, 59*l.* 10*s.* 6*d.*; Shearing, 35*l.* 15*s.* 2*d.*				95	5	8
Police:—Metropolitan, 443*l.* 18*s.* 10*d.*; Local, 25*l.*				468	18	10
Clerks and Assistants:—Bankers, 28*l.*; Telegraphs, 3*l.* 9*s.* 1*d.*; Secretary and Stewards, 94*l.* 6*s.* 6*d.*				125	15	7
Superintendents of Stock and Implement Yards, &c.				65	15	0
Foremen and Assistant-Foremen				112	0	5
Yardmen, Foddermen, Grooms, Labourers, &c.				233	9	6
Index Clerk and Money Takers, 155*l.* 16*s.* 7*d.*; Money Changer, Doorkeepers, &c., 70*l.* 17*s.*				226	13	7
Stewards' Expenses, 201*l.* 11*s.* 9*d.*; Assistant Stewards, 48*l.* 6*s.* 11*d.*				249	18	8
Lodgings for Stewards, Judges, and other Officials				198	10	0
Refreshment Allowances				260	1	10
Catalogues:—Implements, 238*l.* 8*s.* 6*d.*; Stock, 274*l.* 3*s.* 4*d.*; Awards, 19*l.* 13*s.*; Plan of Yard, 25*l.*; Carriage and Packing, 27*l.* 12*s.* 6*d.*; Commission on Selling, 46*l.* 17*s.* 6*d.*				631	14	10
Hay, 184*l.* 3*s.*; Straw, 425*l.* 12*s.*; Green Food, 299*l.* 5*s.*				909	0	0
Printing, 619*l.* 14*s.* 6*d.*; Advertising and Bill Posting, 737*l.* 12*s.* 5*d.*				1,357	6	11
Postage, Telegrams, Stationery, Carriage, &c.				127	6	1
Repairs, Insurance, and Carriage of Testing Machinery				104	10	8
Horse and Carriage Hire				78	8	6
Journeys previous to Show, 20*l.* 10*s.*; Expenses of Official Staff, 20*l.* 14*s.* 4*d.*				41	4	4
Milk, 134*l.* 1*s.* 8*d.*; Ice, 6*l.* 15*s.*; Expense at Dairy, 12*l.* 10*s.*				153	6	8
Bee Shed, 20*l.*; Fire Brigade, 16*l.* 10*s.*; Hire of Organ, 1*l.* 1*s.*				37	11	0
Caps and Jackets, 14*l.* 11*s.* 8*d.*; Hire of Chairs, 21*l.* 8*s.* 4*d.*				36	0	0
Surveyor, Veterinary Medicine, Corn, and Petty Payments				12	7	8
Rosettes, 21*l.* 9*s.* 6*d.*; Medals, 10*l.* 16*s.*				32	5	6
Stock: Prizes				4,200	0	0
				£16,288	6	11

Members' Veterinary Privileges.

I.—Visits of the Veterinary Inspector.

1. Any Member of the Society who may desire professional attendance and special advice in cases of disease among his cattle, sheep, or pigs, should apply to the Secretary of the Society, or to the Principal of the Royal Veterinary College, and Consulting Veterinary Surgeon, Camden Town, London, N.W.

2. The remuneration of the Consulting Veterinary Surgeon or Inspector will be 2*l.* 2*s.* each day as a professional fee, and the charge for personal expenses, *when such have been incurred*, will in no cases exceed one guinea per diem. He will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. These charges may, however, in cases of serious or extensive outbreaks of contagious disease, be reduced or remitted altogether, so far as the Members of the Society are concerned, at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

3. The Inspector, on his return from visiting the diseased stock, will report to the Member, and, through the Principal of the Royal Veterinary College, to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

4. When contingencies arise to prevent a personal discharge of the duties, the Consulting Veterinary Surgeon may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

II.—Consultations without Visit.

Personal consultation with Veterinary Inspector	10*s.* 6*d.*
Consultation by letter	10*s.* 6*d.*
Post-mortem examination, and report thereon	21*s.*

A return of the number of applications from Members of the Society during each half-year is required from the Veterinary Inspector.

III.—Admission of Diseased Animals to the Royal Veterinary College, Camden Town, N.W.; Investigations and Reports.

1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the following terms; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs, 3*s.* 6*d.* per week.

No. 2. A detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary of the College or on Farms in the occupation of Members of the Society, will be furnished to the Council quarterly; and also special reports from time to time on any matter of unusual interest which may come under the notice of the Officers of the College

By Order of the Council,

H. M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis

(Applicable only to the case of Persons who are not commercially engaged in the manufacture or sale of any substance sent for Analysis).

THE Council have fixed the following rates of Charges for Analysis to be made by the Consulting Chemist for the *bonâ-fide* and sole use of Members of the Society; who, to avoid all unnecessary correspondence, are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens (if any), must be paid to him by Members at the time of their application:

No. 1.—An opinion of the genuineness and value of bone-dust or oil-cake (each sample) .. .. 5*s.*

„ 2.—An estimate of the value (relatively to the average samples in the market) of sulphate and muriate of ammonia and of the nitrate of potash and soda .. .. 5*s.*

„ 3.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. .. 10*s.*

„ 4.—An analysis of mineral superphosphate of lime for soluble phosphates only, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. 5*s.*

„ 5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it .. .. 10*s.*

„ 6.—An analysis, showing the value of any ordinary artificial manure 10*s.*

„ 7.—An analysis of limestone, showing the proportion of lime .. 7*s.* 6*d.*

„ 8.—An analysis of limestone, showing the proportion of magnesia, 10*s.*; the proportion of lime and magnesia .. .. .. 10*s.*

„ 9.—An analysis of limestone or marls, showing the proportion of carbonate, phosphate, and sulphate of lime and magnesia, with sand and clay .. .. 10*s.*

„ 10.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime .. .. .. 10*s.*

„ 11.—Complete analysis of a soil £3

„ 12.—An analysis of oil-cake or other substance used for feeding purposes, showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre, as well as of starch, gum, and sugar in the aggregate; and an estimate of its value as compared with pure linseed-cake .. .. 10*s.*

„ 13.—Analysis of any vegetable product .. .. 10*s.*

„ 14.—Analysis of animal products, refuse substances used for manures, &c. .. .. from 10*s.* to £1

„ 15.—Determination of the "hardness" of a sample of water before and after boiling .. .. 5*s.*

„ 16.—Analysis of water of land-drainage, and of water used for irrigation £1

„ 17.—Analysis of water used for domestic purposes .. .. .. £1 10*s.*

„ 18.—Determination of nitric acid in a sample of water .. .. 10*s.*

„ 19.—Personal consultation with the Consulting Chemist. (The usual hours of attendance for the Director, Monday excepted, will be from 11 to 2, but to prevent disappointment, it is suggested that members desiring to hold a consultation with the Director should write to make an appointment) .. 5*s.*

„ 20.—Consultation by letter .. .. 5*s.*

„ 21.—Consultation necessitating the writing of three or more letters 10*s.*

The Laboratory of the Society is at 12, Hanover Square, London, W., to which address the Consulting Chemist, Dr. AUGUSTUS VOELCKER, F.R.S., requests that all letters and parcels (postage and carriage paid) from Members of the Society, who are entitled to avail themselves of the foregoing Privileges, should be directed.

GUIDE TO THE PURCHASE OF ARTIFICIAL MANURES AND FEEDING STUFFS.

Feeding Cakes.

1. *Linseed-cake* should be purchased as "Pure," and the insertion of this word on the invoice should be insisted upon. The use of such words as "Best," "Genuine," &c., should be objected to by the purchaser.

2. *Rape-cake for feeding purposes* should be guaranteed "Pure" and purchased by sample.

3. *Decorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

4. *Undecorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

N.B.—All feeding cakes should be purchased in good condition, and the guarantee of the vendor should be immediately checked by a fair sample (taken out of the middle of the cake) being at once sent for examination to a competent analytical chemist. The remainder of the cake from which the sample sent for examination had been taken should be sealed up in the presence of a witness, and retained by the purchaser for reference in case of dispute.

Artificial Manures.

1. *Raw or Green Bones or Bone-dust* should be purchased as "Pure" Raw Bones guaranteed to contain not less than 45 per cent. of tribasic phosphate of lime, and to yield not less than 4 per cent. of ammonia.

2. *Boiled Bones* should be purchased as "Pure" Boiled Bones guaranteed to contain not less than 48 per cent. of tribasic phosphate of lime, and to yield not less than $1\frac{3}{4}$ per cent. of ammonia.

3. *Dissolved Bones* are made of various qualities, and are sold at various prices per ton; therefore the quality should be guaranteed, under the heads of *soluble* phosphate of lime, *insoluble* phosphate of lime, and nitrogen or its equivalent as ammonia. The purchaser should also stipulate for an allowance for each unit per cent. which the dissolved bones should be found on analysis to contain less than the guaranteed percentages of the three substances already mentioned.

4. *Mineral Superphosphates* should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of *soluble* phosphate of lime, at a certain price per unit per cent., no value to be attached to *insoluble* phosphates.

5. *Compound Artificial Manures* should be purchased in the same manner and with the same guarantees as Dissolved Bones.

6. *Nitrate of Soda* should be guaranteed by the vendor to contain from 94 to 95 per cent. of pure nitrate.

7. *Sulphate of Ammonia* should be guaranteed by the vendor to contain not less than 23 per cent. of ammonia.

8. *Peruvian Guano* should be sold under that name, and guaranteed to be in a dry and friable condition, and to contain a certain percentage of ammonia.

N.B.—Artificial manures should be guaranteed to be delivered in a sufficiently dry and powdery condition to admit of distribution by the drill. A sample for analysis should be taken, not later than three days after delivery, by emptying several bags, mixing the contents together, and filling two tins holding about half a pound each, in the presence of a witness. Both the tins should be sealed, one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil silk, about 3 oz. of the well-mixed sample, and send it to 12, HANOVER SQUARE, LONDON, W., by post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 oz., should be sent either by post or railway.

Samples not exceeding 4 oz. in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 oz., for three postage stamps.

Samples not exceeding 12 oz., for four postage stamps.

The parcels should be addressed: DR. AUGUSTUS VOELCKER, 12, HANOVER SQUARE, LONDON, W., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 oz. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 oz., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d*., if under 4 oz.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 oz. Postage, 4*d*. If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 oz. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

H. M. JENKINS, *Secretary.*

Members' Botanical and Entomological Privileges.

The Council have fixed the following Rates of Charge for the examination of Plants, Seeds, and Insects for the *boná-fide* use of Members of the Society, who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

I. BOTANICAL.

No. 1.—A report on the purity, amount and nature of foreign materials, perfectness, and germinating power of a sample of seeds .. .. 5*s.*

" 2.—Detailed report on the weight, purity, perfectness, and germinating power of a sample of seeds, with a special description of the weeds and other foreign materials contained in it .. .. 10*s.*

" 3.—Determination of the species of any weed or other plant, or of any epiphyte or vegetable parasite, with a report on its habits, and the means of its extermination or prevention .. .. 5*s.*

" 4.—Report on any disease affecting the farm crop .. .. 5*s.*

" 5.—Determination of the species of a collection of natural grasses found in any district on one kind of soil, with a report on their habits and pasture value .. .. 10*s.*

II. ENTOMOLOGICAL.

" 6.—Determination of the species of any insect, worm, or other animal which, in any stage of its life, injuriously affects the farm crops, with a report on its habits and suggestions as to its extermination .. .. 5*s.*

INSTRUCTIONS FOR SELECTING AND SENDING SPECIMENS.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plant must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tin-foil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., 4, Woodside Villas, Gipsy Hill, London, S.E.

H. M. JENKINS, *Secretary.*

THE

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY

OF ENGLAND.

SECOND SERIES

VOLUME THE SEVENTEENTH.

PRACTICE WITH SCIENCE.

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1881.

These experiments, it is true, are not easy; still they are in the power of every thinking husbandman. He who accomplishes but one, of however limited application, and takes care to report it faithfully, advances the science, and, consequently, the practice of agriculture, and acquires thereby a right to the gratitude of his fellows, and of those who come after. To make many such is beyond the power of most individuals and cannot be expected. The first care of all societies formed for the improvement of our science should be to prepare the forms of such experiments, and to distribute the execution of these among their members.

Van Thaer, *Principles of Agriculture.*

London: Printed by William Clowes and Sons, Limited,
Stamford Street and Charing Cross.

CONTENTS OF VOLUME XVII.

Second Series.

APPENDIX.

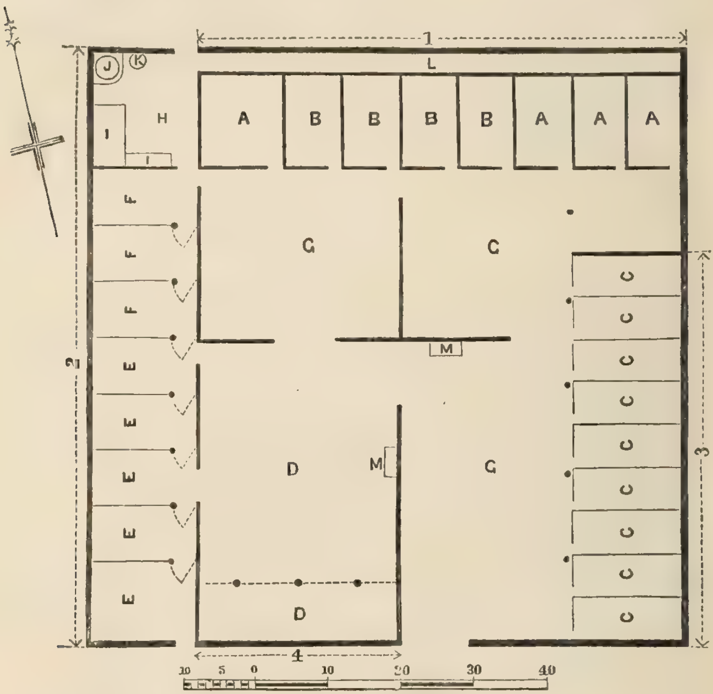
DIRECTIONS TO THE BINDER.

The Binder is desired to collect together all the Appendix matter, with Roman numeral folios, and place it at the *end* of each volume of the Journal, excepting Titles and Contents, and Statistics &c., which are in all cases to be placed at the *beginning* of the Volume; the lettering at the back to include a statement of the *year* as well as the *volume;* the first volume belonging to 1839–40, the second to 1841, the third to 1842, the fourth to 1843, and so on.

In Reports of the Journal all Appendix matter and, in one instance, an Article in the body of the Journal (which at the time had become obsolete), were omitted; the Roman numeral folios, however (for convenience of reference), were reprinted without alteration in the Appendix matter retained.

ERRATA.

In Mr. Howard's paper, p. 217, the references to the Plan of the Piggeries at Clapham Park Farm were omitted, and the Plan is therefore now reprinted, with its explanation added:—



A. Farrowing Sties.
B. Sties for young Pigs.
C. Sties for Boars.
D. Shed and yard for Sows in-pig.
E. Boxes for Pigs or Calves.
F. Boxes used for Farrowing, or for Sows with litter.
G. Feeding and Exercise yards, brick-paved.

H. Boiling-house.
I. Steaming-apparatus and flour-bins.
J. Egg-shaped boiler.
K. Copper furnace.
L. Passage.
M. Water troughs.
Sheds marked 1 and 2 are enclosed.
Sheds marked 3 and 4 are open in front.

In Mr. Carruthers's paper, p. 84, line 10 (exclusive of Table), *for* "No. 1 Red Wheat as second," *read* "No. 2 Red Wheat as second."

JOURNAL

OF THE

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

XXII.—*On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted.* By J. B. Lawes, LL.D., F.R.S., F.C.S., J. H. Gilbert, Ph.D., F.R.S., F.C.S., and R. Warington, F.C.S.

Part II. The Amount and Composition of the Drainage-Waters from Unmanured Fallow Land (*continued from page* 279 *).

2. *The Measured Drainage, and the Evaporation* (*continued*).—Having now disposed of the preliminary questions belonging to the subject, we may proceed to consider the general facts exhibited by the ten years' drainage experiments.

In the following Table (p. 312) the rainfall and drainage of each of the summer and winter periods during the past ten years are shown; the rainfall and drainage for each twelve months—October 1 to September 30—are also given. This period of twelve months we may, for our present purpose, call the "Drainage Year;" and our mode of record will thus agree with the division into Civil-year periods adopted by Mr. Greaves and Mr. Evans. The whole of the seasons are arranged in the table in the order of their respective rainfall; the influence of varying amounts of rain is thus clearly shown. The amounts of drainage given are the mean of the results yielded by the three drain-gauges, 20, 40, and 60 inches in depth.

The range of rainfall during the ten years of the experiment is seen to have been enormous. We have a consecutive twelve

* In the preceding number of this 'Journal' will be found the First Part of the present Paper, treating of "The Amount and Composition of the Rainfall;" also a portion of the Second Part, now completed. The former portion of the Second Part included (1) a description of the soil drain-gauges, and (2) an account of the amounts of monthly drainage obtained from 1870 to 1880.

TABLE XXI.—The AMOUNTS of RAINFALL, DRAINAGE, and EVAPORATION for the TEN SUMMERS, WINTERS, and DRAINAGE-YEARS, during the PERIOD 1870–80 (DRAINAGE MEAN of 20, 40, and 60-INCH GAUGES).

Summer: April—September.				Winter: October—March.				Drainage-Year: October—September.			
Season.	Rainfall.	Drainage.	Evaporation.	Season.	Rainfall.	Drainage.	Evaporation.	Season.	Rainfall.	Drainage.	Evaporation.
1873	11·633	0·923	10·710	1879–80	7·031	3·948	3·083	1873–4	22·937	4·970	17·967
1874	13·097	1·052	12·045	1873–4	9·840	3·918	5·922	1879–80	24·087	9·808	14·279
1872	14·147	1·645	12·502	1871–2	12·165	6·032	6·133	1871–2	26·312	7·677	18·635
1877	14·429	3·139	11·290	1870–1	12·768	5·546	7·222	1870–1	29·317	9·631	19·686
1876	14·921	3·898	11·023	1874–5	13·407	7·281	6·126	1874–5	30·791	12·200	18·591
1871	16·549	4·085	12·464	1877–8	13·919	9·084	4·835	1872–3	31·620	13·772	17·848
1880	17·056	5·860	11·196	1878–9	16·964	13·586	3·378	1877–8	32·586	15·216	17·370
1875	17·384	4·919	12·465	1875–6	19·280	13·185	6·095	1875–6	34·201	17·083	17·118
1878	18·667	6·132	12·535	1872–3	19·987	12·849	7·138	1876–7	35·793	18·669	17·124
1879	25·754	12·271	13·483	1876–7	21·364	15·530	5·834	1878–9	42·718	25·857	16·861
Mean..	16·364	4·393	11·971	Mean..	14·673	9·096	5·577	Mean..	31·036	13·488	17·548

months with a rainfall of 22·937 inches, and another similar period with a fall of 42·718 inches. In the six winter months the range of rainfall has been still greater, namely from 7·031 to 21·364 inches. The ten years of experiment have thus afforded examples of extreme rainfall and drought, such as are usually only found in much longer periods of observation.

With this very large variation in the rainfall we have a yet greater variation in the amount of water passing through the soil. The summer drainage is seen to vary from 0·923 to 12·271 inches; the winter drainage from 3·918 to 15·530 inches; and the drainage of the whole drainage-year from 4·970 to 25·857 inches. Expressed in percentages of the rainfall the drainage in summer has varied from 7·9 to 47·6, with a mean of 26·8 per cent.; the drainage in winter from 39·8 to 80·1, with a mean of 61·9 per cent.; and the drainage of the whole year from 21·7 to 60·5, with a mean of 43·4 per cent.

To understand the cause of this extreme variation in the amount of water passing through the soil we must turn our attention to the amount of evaporation from the surface which has at the same time taken place, and which is also shown in the table. The amounts of evaporation during each season have been ascertained by simply subtracting the amount of drainage from the amount of rainfall. That portion of the rainfall which does not appear as drainage-water has clearly been returned to the atmosphere by evaporation; this is true, at all events, when the soil holds a similar amount of water at the beginning and end of the period of the experiment. That the soil of the drain-gauges was actually in a similar state of dryness at the beginning and end of every period mentioned in the table is by no means asserted; the figures representing the evaporation are thus perhaps seldom quite exact, and in a few cases are certainly in error. The error is, however, usually small, as at the commencement and end of the periods chosen (October 1 and April 1) the soil will generally contain a moderate, but not excessive, amount of water. In the mean evaporations for summer and winter, given at the foot of the table, the error just mentioned will be but small; and in the mean evaporation for the whole year probably *nil*.

The amount of evaporation taking place from a bare uncropped soil will depend on the temperature of the soil, the temperature and dryness of the air, and the amount of wind, and also on the amount and distribution of the rain: the amount of evaporation is, in fact, limited not only by the conditions as to heat, wind, &c., but also by the amount of water available on the surface.

The distribution of the rain has a considerable influence on the amount of evaporation; a heavy rainfall occurring in a few

days will always result in more drainage and less evaporation than the same quantity of rain distributed over a month; and to this cause some of the variations in drainage with a similar rainfall, to be found in Table XXI., are plainly due. In the Rothamsted drain-gauges, however, containing as they do a heavy soil in its natural condition of consolidation, and with its clay subsoil untouched, the differences in the amount of drainage due to irregularities in the distribution of the rain are far smaller than those which have been observed by other persons employing small percolators more or less loosely filled with porous soil, and generally with growing turf upon the surface.

Turning now to the figures of the table, we see that the amount of evaporation from the soil during the whole drainage-year appears, with two marked exceptions, to be a fairly constant quantity. The whole range of evaporation in ten years is from 14·279 to 19·686 inches; but excluding these extremes, the variation in eight years is only from 16·861 to 18·635 inches. That in years of very different rainfall the soil has evaporated almost the same amounts of water, is strikingly shown by many of the results, as for instance those for 1873–4, 1872–3, and 1876–7.

The large amount of evaporation credited to the year 1870–1, is probably due to an error in estimation of the kind already noticed. The drain-gauges were constructed during the exceedingly dry summer of 1870, and the blocks of soil to be included in the gauge having been isolated by trenches cut round them, were necessarily more or less exposed to air on all their sides; the soil was thus dried to an unusual extent, and when rain commenced a considerable amount was consumed in wetting the soil before drainage took place. Under these circumstances it is clear that a part of the rain credited to evaporation was really retained by the dry soil, the true evaporation was consequently distinctly below the estimated quantity.

The extremely low evaporation of the year 1879–80, and the rather low result for 1878–9, are chiefly owing to the abnormal evaporations calculated for the winters of these years, the cause of which will be presently considered.

The amounts of evaporation for the summer half of the year also display considerable uniformity, notwithstanding great variations in the rainfall. During ten summers the smallest evaporation has been 10·710, and the largest 13·483 * inches.

* This calculated figure is undoubtedly rather higher than the true evaporation. The summer six months succeeded a dry March and concluded with a wet September, nearly 1 inch of rain falling in the last three days of this month. The drainage is thus from two causes somewhat below the amount naturally belonging to the rainfall, and the calculated evaporation is to the same extent too high.

Excepting these extremes, the variation in eight years has been only from 11·023 to 12·535 inches.

This comparative constancy of the evaporation under very different conditions of climate is certainly remarkable; it must be greatly due to the fact that the two principal conditions which determine a large evaporation, namely excessive heat and abundant rain, very rarely occur together. In a wet season, when the soil is kept well supplied with water, there is at the same time a more or less saturated atmosphere, with an absence of sunshine, conditions unfavourable to a considerable evaporation. In a hot season there is, on the other hand, usually a scarcity of rain; and after the surface of the soil has dried evaporation must proceed very slowly.

The figures representing the evaporation from the soil during the winter half of the year are by no means so regular as those relating to the summer half, or to the whole year. This is partly due to the small amount of the evaporation, which is naturally, therefore, considerably affected by any disturbing cause. A nearer study of the results shows, however, that the evaporation is considerably more constant than at first appears. Both in 1870–1 and in 1872–3 the high calculated figure for evaporation is certainly in excess of the truth; in each case the soil was unusually dry just before the commencement of the winter period, and in the latter winter it was also somewhat unusually wet at the end of this period: rain has thus been reckoned as evaporation which really was simply retained by the soil. Errors of reckoning of this description are naturally greater in the case of the deeper drain-gauges, and least in the case of the 20-inch gauge. With this gauge the range of the evaporation calculated for the winter months is much smaller than with the other gauges; omitting 1878–9 and 1879–80, the range with this gauge is but from 5·182 to 6·924 inches.

The winters of 1878–9 and 1879–80 show a remarkably small calculated evaporation, and considerably diminish the total evaporation of the years of which they form part. The winter of 1879–80 is the most striking of these exceptions; it succeeded the wettest summer in the whole ten years, while the winter itself was the driest and coldest in the same period. The rainfall of October and January being insufficient to provide for a normal evaporation, and the low temperature tending also to a reduced rate of evaporation, we should expect the amount of evaporation during this winter to be somewhat below the average. A more potent cause of the extremely low figure found by calculation is, however, the abnormally high drainage. The soil commenced October in a saturated condition, while the winter concluded with a fairly dry March; a part of the winter drainage thus belonged to the summer rainfall—a most unusual cir-

cumstance. The very exceptional high rate of drainage during January and February cannot, however, be explained by reference to the previous summer's rainfall, and certainly points to a condensation of water by the soil, probably occurring at the close of the severe frost experienced during those months.

The winter of 1878–9 was not quite so exceptional as the one last mentioned. It followed a wet summer, and concluded with a dry March, the temperature was also nearly as low as in the winter of 1879–80; some of the circumstances tending to produce a low evaporation and high drainage were thus the same in both seasons, though not so marked in 1878–9 as in 1879–80. The evidence of condensation of water by the soil during January and February was, however, still more distinct during the winter now under consideration, the drainage of January and February being far above the normal proportion to the rainfall.

We conclude, therefore, that these winters had probably a rate of evaporation rather below the average; but the serious deficiency shown by the figures in the table had probably no existence, being simply due to a special increase of the drainage from sources independent of the rainfall of the period.

We now turn to the average amounts of evaporation for each season given at the foot of Table XXI. The rate of evaporation having altered, on the whole, within moderate limits during the last ten years, these figures will express with tolerable accuracy the amount of evaporation which will ordinarily take place from the Rothamsted soil when kept bare of vegetation, in a climate having a mean temperature of about 48°. The average amount of evaporation during the six summer months will be nearly 12 inches, during the six winter months about $5\frac{1}{2}$ inches,* and for the whole year 17 to 18 inches.

We have dwelt thus at length on the amount of evaporation from the soil of the drain-gauges because the comparative constancy of the evaporation from the surface of a bare clay soil in seasons of very different character is probably a novel fact, and because this constancy in the amount of evaporation is, in the case of our drain-gauges, the law which determines in the long run the amount of drainage. Drainage is in fact merely the *excess of rainfall over evaporation.* With this view of drainage in our minds, the cause of the great variation in its amount becomes readily understood; for we may almost say

* The average evaporation from a water surface during the six winter months is according to Mr. Greaves only 4·766 inches. Are we to conclude that under some circumstances the evaporation from a bare soil may be greater than from water? Or that Mr. Greaves's result is diminished by a condensation of water from the atmosphere greater than is experienced at Rothamsted? Or, on the other hand, is the evaporation calculated for our soil too high, from the errors known to affect the reckonings for the autumn months (see page 319)? It is impossible at present to give a definite answer to these questions.

that up to the point at which the rainfall equals the evaporation of the season no drainage will take place, but that beyond that point every inch of rain will produce an inch of drainage-water. This general statement assumes of course ordinary and not extraordinary conditions, and it is true of long periods rather than short ones; in short periods the immediate distribution of the rain will certainly have a preponderating effect. The cause of the immense excess of winter over summer drainage becomes now apparent. The rainfall in summer is actually in excess of that in winter, but the drainage during the summer months is only half that experienced in winter, owing to the far greater amount of evaporation during the warmer half of the year.

As to the various rates of evaporation from soils of different depths, the drain-gauges unfortunately give, as we have already seen, no certain information. The average evaporation from the 20, 40, and 60-inch gauges are separately given at the foot of Table XXII. (p. 318); the figures we have discussed have been in all cases a mean of the three results. With soils more open than that at Rothamsted, of less water-holding capacity, and of lower capillary power, the amount of evaporation will be much less, and the proportion of the rainfall which appears as drainage far greater. The amount of evaporation in such soils is also more variable, the surface possessing no regular supply of water. The behaviour of soils of this description is shown in an exaggerated manner by Mr. Greaves's experiment on a mass of pure sand, the general results of which will be found in Table XXV. (p. 325). On the other hand, with soils of greater water-holding power, or with a heavier summer rainfall, the amount of evaporation during the summer months, and consequently for the whole year, might be somewhat increased; but the possible range of variation in this direction is not large, as Mr. Greaves has shown that the average annual evaporation from a water surface is but 20·658 inches, or only about 3 inches greater than that obtained from the Rothamsted soil.

To complete our view of the results yielded by the drain-gauges we must now proceed a step further, and see what has been the average amount of drainage and evaporation for each month in the year.

It appears from Table XXII. that drainage has on an average commenced in earnest in September, and remained at a high point till March, that is, during the periods usually designated as "Autumn" and "Winter"; the maximum drainage being reached in November or January. From March to August ("Spring" and "Summer") the drainage has been comparatively small, the minimum having occurred in May. In considering these figures it must, however, be borne in mind that the rainfall

TABLE XXII.—The AVERAGE MONTHLY RAINFALL, with the AVERAGE MONTHLY PERCOLATION and EVAPORATION from SOIL 20, 40, and 60 INCHES in DEPTH, during 10 YEARS, 1871–80.

	Rainfall.	Drainage.			Evaporation.		
		Soil 20 Inches Deep.	Soil 40 Inches Deep.	Soil 60 Inches Deep.	Soil 20 Inches Deep.	Soil 40 Inches Deep.	Soil 60 Inches Deep.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January ..	2·802	2·006	2·294	2·030	0·796	0·508	0·772
February ..	2·100	1·401	1·536	1·378	0·699	0·564	0·722
March ..	1·595	0·540	0·675	0·585	1·055	0·920	1·010
April	2·398	0·810	0·921	0·852	1·588	1·477	1·546
May	2·224	0·422	0·501	0·433	1·802	1·723	1·791
June	2·663	0·521	0·535	0·486	2·142	2·128	2·177
July	3·280	0·890	0·918	0·804	2·390	2·362	2·476
August* ..	2·677	0·670	0·663	0·609	2·007	2·014	2·068
September ..	3·123	1·170	1·044	0·927	1·953	2·079	2·196
October ..	3·162	1·694	1·682	1·414	1·468	1·480	1·748
November ..	3·094	2·158	2·241	1·999	0·936	0·853	1·095
December ..	2·333	1·758	1·906	1·724	0·575	0·427	0·609
Whole Year	31·451	14·040	14·916	13·241	17·411	16·535	18·210

during the ten years of the drainage experiments has been singularly abnormal; not only has the annual fall been excessive (about 3 inches above the average), but the distribution has been irregular, certain months having been specially affected. If we assume, as we fairly may, that the amounts of monthly evaporation ascertained for the past ten years would remain nearly the same under a normal rainfall, it becomes possible by simply subtracting the excess, or adding the deficiency of the rainfall, to calculate what would be approximately the monthly drainage under a rainfall of average amount. The results of such a calculation will be found in Table XXIII.

It should be stated that in the construction of this artificial Table (XXIII.), exceptional rainfalls and drainage, such as those of August 1879, are not excluded. The figures as they stand would indicate that under a normal rainfall considerable drainage would not set in before October, and would continue to the end of February, the maximum drainage being in January. From March to the end of September the amount of drainage is comparatively small, the minimum being reached in June and July. If these indications should prove to be correct, the natural drainage year of this uncropped land would commence with October, the first autumn month in which a great fall of temperature occurs, and also the month of maximum rainfall.

* Excluding the very exceptional rainfall and drainage of August 1879, the average drainage for the month would be only about one-third as much as the figures show.

TABLE XXIII.—CALCULATED AVERAGE MONTHLY DRAINAGE from SOIL 20, 40, and 60 inches in depth, when RAINFALL is of Normal Quantity.

	Rainfall.		Rain of 10 Years under or above Rain of 28 Years.	Drainage, assuming normal Rain.		
	Average 28 Years, 1853–80.	Average 10 Years, 1871–80.		Soil 20 inches deep.	Soil 40 inches deep.	Soil 60 inches deep.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	2·590	2·802	+0·212	1·794	2·082	1·818
February ..	1·728	2·100	+0·372	1·029	1·164	1·006
March	1·693	1·595	−0·098	0·638	0·773	0·683
April	2·008	2·398	+0·390	0·420	0·531	0·462
May..	2·329	2·224	−0·105	0·527	0·606	0·538
June	2·451	2·663	+0·212	0·309	0·323	0·274
July..	2·704	3·280	+0·576	0·314	0·342	0·228
August	2·643	2·677	+0·034	0·636	0·629	0·575
September ..	2·638	3·123	+0·485	0·685	0·559	0·442
October	3·089	3·162	+0·073	1·621	1·609	1·341
November ..	2·345	3·094	+0·749	1·409	1·492	1·250
December ..	2·084	2·333	+0·249	1·509	1·657	1·475
Whole Year ..	28·302	31·451	+3·149	10·891	11·767	10·092

We must now glance at the average amounts of evaporation during each month, which have been given in Table XXII. Looking first at the results obtained with the 20-inch drain-gauge we see that evaporation from the soil takes place to the smallest extent in December. In January it is slightly greater, the smaller supply of radiant heat during the short days of December checking evaporation apparently more than the lower air temperature of January. In February evaporation remains little altered, but in March a decided rise commences, continuing steadily up to July, when the maximum rate of evaporation is attained ; from this point a decline sets in till the minimum is once more reached in December.

The amount of water evaporated per month is not always, however, exactly shown by the mode of calculation we are forced to adopt. We have already frequently called attention to the error which must occur in our calculations when the soil is drier or wetter at the end of the experimental period than it was at the beginning. This source of error only occasionally affects the correctness of our calculations when the period in question is a long one, or when the average of many similar periods can be obtained in which it is an equal chance whether the soil is drier or wetter at the end than at the beginning, but it certainly distinctly affects a portion of the monthly averages. The amounts of evaporation calculated for the mid-winter months will be practically free from errors of this description, if the average of a sufficient number of years be taken. From winter,

however, to the height of summer, the soil must generally tend to become drier, and the calculated evaporation for the months lying in this period will consequently be on the whole too low. The hottest season passed, a reverse action will take place, the soil gradually becoming more saturated with water; the figures given as representing evaporation during this portion of the year will therefore be too high. A comparison of the amounts of evaporation calculated for the Rothamsted soil with the average monthly evaporation determined by Mr. Greaves for a water-surface (see Table XXV., p. 325) is most instructive, and shows very clearly the existence of the two errors in opposite directions which affect our calculations for spring and autumn.

During December, January, February and March, the amounts of evaporation from a water-surface are seen to be all but identical with the evaporation calculated for the soil of the 20-inch gauge at Rothamsted, plainly showing that the soil is during these months sufficiently saturated with water to yield at all times a maximum rate of evaporation. During the warmer months of the year we should expect to find the evaporation from the water uniformly greater than from the soil, as the soil is not at this time of the year permanently saturated. We find, however, that while the evaporation from a water-surface considerably exceeds that from the soil from April to August, the evaporation from the soil is distinctly greater during September, October and November, the difference in favour of the soil during these months amounting on the whole to 1 inch. Under spring and autumn seasons of similar temperature we find, therefore, that in the spring the evaporation from water exceeds that calculated for the soil, while in autumn the converse holds true. This is quite in accordance with our previous reasoning. There can be little doubt that the evaporation credited to the soil for September and October is somewhat too high, while that reckoned for April and May is rather too low.

On comparing the records of the 20, 40, and 60-inch gauges given in Table XXII. (p. 318), it is evident that the relation between them is different at different times of the year. In the spring months drainage will continue to take place from the lower layers of a deep soil when it has altogether ceased in a shallower soil. In summer and autumn, on the other hand, the drainage will be less from the deeper soil, as there is in this case a larger mass of dry soil to be saturated with water before drainage can commence. In March and April the drainage from the soil 40 and 60 inches in depth, is on an average rather greater than that from similar soil 20 inches deep; but in August, September, and October, the relation is reversed, the shallowest soil yielding the largest drainage. These facts appear in the records of the gauges for the last six years, as

well as in the records for the first four years; the extent of difference is, however, much less in the later years. It clearly follows from these facts that the errors affecting the calculated amount of evaporation from the soil during the spring and autumn months will be greatest in the case of the deeper soils, and that the calculations made on the results of the 20-inch gauge will most nearly represent the truth.

In the next table the average monthly drainage from the three gauges is given as percentages of the rainfall; in the same table will be found the percentage relation of the assumed normal drainage (see Table XXIII., p. 319) to the normal rainfall, the average of twenty-eight years.

TABLE XXIV.—AVERAGE MONTHLY DRAINAGE for 100 RAINFALL during 10 YEARS, 1871–80. Also the DRAINAGE for 100 RAINFALL with assumed normal quantities of both.

	Observed Drainage for 100 Rainfall.			Normal Drainage for 100 Normal Rainfall.		
	Soil 20 inches deep.	Soil 40 inches deep.	Soil 60 inches deep.	Soil 20 inches deep.	Soil 40 inches deep.	Soil 60 inches deep.
January	71·6	81·9	72·4	69·3	80·4	70·2
February ..	66·7	73·1	65·6	59·5	67·4	58·2
March	33·8	42·3	36·6	37·7	45·7	40·3
April	33·8	38·4	35·5	20·9	26·4	23·0
May	19·0	22·6	19·5	22·6	26·0	23·1
June	19·6	20·1	18·3	12·6	13·2	11·2
July	27·1	28·0	24·5	11·6	12·6	8·4
August	25·0	24·8	22·8	24·1	23·8	21·8
September ..	37·5	33·4	29·7	26·0	21·2	16·7
October	53·6	53·2	44·7	52·5	52·1	43·4
November ..	69·7	72·4	64·6	60·1	63·7	53·3
December ..	75·3	81·7	73·9	72·4	79·5	70·8
Whole Year ..	44·6	47·4	42·1	38·5	41·6	35·7

These figures will require no explanation. The average percentages of drainage to rainfall during summer and winter have been already given (page 313). The mean annual proportion of drainage to rainfall there given is not exactly the same as in the above table, the former results being the mean of ten drainage-years, and the latter of ten civil years.

If we may assume a comparatively constant annual evaporation from the surface of the soil, it becomes possible to calculate approximately the percentage of drainage to rainfall for any given rainfall distinctly exceeding the amount of evaporation. Thus assuming 17·5 inches as the annual amount of evaporation, then with a rainfall of 28·3 inches (the present average at Rothamsted), the drainage will amount to about 38 per cent.

With a rainfall of 25 inches, the drainage would in like manner be 30 per cent. With a rainfall of 20 inches, 12·5 per cent.

It must be carefully borne in mind that the whole of the facts and figures hitherto given relating to drainage and evaporation have reference to a soil entirely bare of vegetation, and consequently are only partially applicable to ordinary land which is always more or less covered with vegetable growth.

We have now gone through the principal facts which the amounts of percolation from the three drain-gauges appear to teach. That experiments with soils kept bare of vegetation can only touch a part of the questions connected with practical agriculture is most true. A series of percolation experiments in which the influence both of crop and manure on the amount and composition of the drainage-water might be studied, was planned many years ago, but has not been brought to a successful issue. Eighteen cylinders made of stone-ware pottery, each 5 feet in depth and 2 feet in diameter, were sunk in the ground nearly to their upper edge. It was intended that these cylinders should be filled with soil similar in kind to that forming the three drain-gauges. Crops would then have been grown, and manures applied, the drainage-water passing through the soil collected and measured, and its composition determined by analysis. The substances applied as manure, and removed in the crop and drainage-water, being thus known, it was hoped that valuable information would be obtained on many important questions. Unfortunately the cylinders were found to leak. It also proved impossible to get into them the amount of soil necessary to obtain the same degree of consolidation as that occurring in a natural field, although much water was poured through, and a pressure exceeding one ton was in some cases applied. No further steps have yet been taken.

Several investigations have been made at Rothamsted on the subject of the evaporation of water by plants, both when grown in pots * and in the field. In a paper published in this 'Journal' in 1871 (page 91), calculations are given as to the amount of water removed from the soil by certain crops during the hot and dry summer of 1870, the calculations being based on actual determinations of the amount of water remaining in the soil after the removal of the crops. Thus it was shown that a crop of manured hay of $29\frac{1}{2}$ cwts. had removed from the soil at least 2 inches, and another manured crop of $56\frac{1}{4}$ cwts. at least 3·2 inches more water than an unmanured crop of $5\frac{3}{4}$ cwts. In the case of a crop of barley grown on the same field in which the drain-gauges were afterwards established, the crop had appa-

* "Experimental Investigation into the Amount of Water given off by Plants during their Growth, especially in relation to the fixation and source of their various constituents." —Jour. Hort. Soc. Lond. v. 38. 1850.

rently removed from the soil about 9 inches more water than had evaporated from the adjoining bare fallow; the conditions of the experiment were, however, not all that could be desired.

The powerful action of a crop in evaporating water from a soil is mainly due to the rapid transpiration of water through the leaves, which takes place in a growing plant under the influence of light; the roots also lend important assistance by enabling the plant to draw water from depths of the soil too great to be disturbed by ordinary capillary attraction. A deeply rooted crop may thus be more effective in drying the soil than a crop with shallow roots, as is plainly seen by a comparison of the results produced by the grass and barley-crops already mentioned.

As the transpiration of water in a plant is determined by light, the amount of transpiration must have some connection with the rate of assimilation and growth. When the supply of water and of soluble plant-food is tolerably constant, the relation between transpiration and growth will be fairly regular. From experiments made at Rothamsted many years ago, with plants grown in pots, it was concluded that from 250 to 300 lbs. of water were evaporated for 1 lb. of dry matter added to the plant. It may be, however, that in a soil poor in soluble plant-food a larger amount of water would pass through the crop to yield the same amount of assimilation than in the case of a soil well manured. The relation between transpiration and assimilation will, indeed, probably differ under different circumstances.

The annual evaporation from a cropped soil can never be reckoned as a constant quantity, even under a uniform course of cropping, as the character of the season will greatly affect the growth of the crop, and consequently its evaporating power. The evaporating power of a crop is also so often above the average rainfall of the period of its active growth, that it is only occasionally that the full extent of this power is manifested.

We must now conclude this section with a word regarding the results of others in this branch of inquiry.

Dr. Dalton, as far back as 1796, constructed a percolation-gauge, consisting of a cylinder 3 feet deep, filled with soil, and sunk in the ground to the level of its upper edge, arrangements being made for collecting and measuring the water which passed through. This mode of experimenting has been adopted by many observers, as M. Maurice, M. Gasparin, Messrs. Dickinson and Evans, Mr. Greaves, Prof. Ebermayer,* Dr. Sturte-

* A brief notice of the results of Maurice, Gasparin, Ebermayer, and others, with a summary of those obtained at Rothamsted up to that date, will be found in the Minutes of Proceedings of the Institution of Civil Engineers, Session 1875–6, vol. XLV. part iii.

vant, &c. It is obvious that on this plan the soil forming the drain-gauge is more loose and open in texture than the natural consolidated soil of a field, thus admitting a freer percolation; pains also have seldom been taken to include the natural subsoil in the percolation-cylinder, which has generally been filled entirely with a surface soil. The surface of the gauge has again not been interfered with, and has speedily become covered by a mass of grass and weeds. The evaporating power of the soil is of course greatly increased by the presence of this vegetation. Of the results obtained by the use of Dalton gauges by far the most extensive are those by Mr. Dickinson, of Nash Mills, Hemel Hempstead, Herts, commencing in 1836,* and latterly continued by Mr. J. Evans; and those commenced by Mr. C. Greaves at Lee Bridge in 1851, and carried on to the present time. We shall refer to the results of these experimenters in some little detail, as they excellently illustrate the influence of a crop on percolation and evaporation.

Messrs. Dickinson and Evans have employed two drain-gauges, consisting of cast-iron cylinders 3 feet in depth, and 18 inches in diameter; one is filled with the surface soil of the neighbourhood, the other with fragments of chalk; both bear a growth of grass. Mr. Greaves's drain-gauges consist of two square boxes made of slate, 3 feet in depth and 3 feet square; one of these is filled with sand (such as is employed for filter-beds, passing through a screen of 33 No. 10 wires in 6 inches) to within 2 inches of the top; the other with a mixture of soft loam, gravel and sand, trodden in and turfed. Mr. Greaves has also a gauge for measuring the evaporation from a water-surface, consisting of a tank 1 foot in depth, and having an area of 1 square yard; this tank is kept afloat in a flowing stream. The tank contains a few inches of water, the rise or fall in which is ascertained from time to time. This is probably the most accurate method of determining the rate of evaporation from water yet adopted. The figures we shall quote are taken from two papers read by Mr. Greaves and Mr. Evans before the Institution of Civil Engineers, February 29, 1876; these supply us with the results of Mr. Greaves for fourteen years—1860–73, and those of Mr. Evans for fifteen drainage-years—1860–1 to 1874–5. The following Table (p. 325) gives a summary of Mr. Greaves's results:—

The mass of sand which fills one of the percolators supplies an extreme example of a soil of the lowest water-holding and capillary power; the rain passes through it without hindrance,

* The results for the first eight years will be found in the volume of this 'Journal' for 1845, page 150.

TABLE XXV.—MR. GREAVES'S RESULTS respecting DRAINAGE and EVAPORATION, average of 14 YEARS, 1860–73.

	Rainfall.	Drainage.		Evaporation.		
		Sand.	Turfed Soil.	Sand.	Turfed Soil.	Water.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	2·870	2·734	2·029	0·136	0·841	0·761
February ..	1·596	1·524	1·085	0·072	0·511	0·603
March	1·936	1·605	0·879	0·334	1·060	1·065
April	1·428	1·117	0·275	0·311	1·153	2·098
May	2·056	1·656	0·105	0·400	1·951	2·753
June	2·205	1·572	0·156	0·633	2·049	3·142
July	1·774	1·212	0·013	0·562	1·761	3·443
August	2·332	1·783	0·113	0·549	2·219	2·850
September ..	2·347	1·737	0·071	0·610	2·276	1·606
October	2·730	2·402	0·515	0·328	2·215	1·056
November ..	2·021	1·963	0·833	0·058	1·188	0·707
December ..	2·422	2·173	1·508	0·249	0·914	0·574
Whole Year ..	25·720	21·478	7·582	4·242	18·138	20·658

and but little water is evaporated from the surface even in the height of summer. In the whole year the quantity calculated as evaporated amounts to but 4·242 inches. The true amount of evaporation is probably, however, greater than this, as it is not very uncommon for the drainage from this gauge to exceed the rainfall, owing, as Mr. Greaves supposes, to condensation of water directly from the atmosphere. This excess of drainage over rain occurs most frequently in January and February.

On the turfed soil the amount of evaporation from January to March is very similar to that observed on the bare soil at Rothamsted; but from April to September—the growing season of the grass,—practically no drainage takes place, nearly the whole of the rainfall being evaporated. Drainage-water was indeed collected in July and August only on two, in June on three, and in May and September on four occasions during the fourteen years. The average amounts of water evaporated from the turf during summer, winter, and the whole year, namely, 11·409, 6·731, and 18·138 inches, are very similar to those noted at Rothamsted; they are so, however, simply from the very moderate amount of rainfall supplied to the soil. In the wet summer of 1860, 15·608 inches were evaporated by the turf in six months; and in the wet season of 1872, the evaporation during twelve months reached 25·141 inches. There is thus but little constancy in the amount of evaporation, which depends largely on the amount of rainfall, and on the activity of the vegetation. With a heavier rainfall we should doubtless obtain more constant figures.

The figures representing the evaporation from a water surface are full of interest. The average summer evaporation is 15·892 inches; that for winter, 4·766 inches; the total for the year, 20·658 inches. The amount of variation is very considerable. In 1862 the annual evaporation was only 17·332 inches; in the hot season of 1868 it reached 26·933 inches. There are some obvious reasons why the evaporation from a water surface should be more variable than that from a bare soil. On a water surface sunshine and wind must always produce their full effect, while on soil evaporation receives a check as soon as the surface is dried. Another disturbing cause in Mr. Greaves's determinations has been variable condensation from the atmosphere, making the winter evaporations appear lower than they really are.

Mr. Evans's experiments are even more striking examples of the disturbing action of vegetation than those of Mr. Greaves. The average rainfall during fifteen years has been 25·55 inches. Throughout this period the absence of drainage from the turfed soil during the summer months has been even more complete than in Mr. Greaves's experiments. The summer drainage from the turfed soil has averaged 0·35 inch, the evaporation 12·12 inches. The winter drainage has been 5·23 inches, the evaporation 7·85 inches. In the whole drainage-year the average drainage has been 5·58 inches, the evaporation 19·97 inches. The summer evaporation, however, actually ranges from 7·59 to 16·09 inches, and that of the whole year from 13·20 to 26·55 inches. This wide range in the amount of evaporation is in part due to the insufficient supply of rain. The full evaporating power of the turf has perhaps not yet been shown, the whole of the rainfall having been evaporated even in the wettest summer of the fifteen years. In these experiments the distribution of the rain has a marked effect on the amount of drainage. Rainfalls not sufficiently heavy to penetrate the turf are probably evaporated, while those passing the turf appear, more or less, as drainage.

In the percolator filled with chalk, the average annual drainage has been 8·79 inches, and the evaporation 16·76 inches. In this case the soil would probably be less compact, and the growth of grass less vigorous, than in the percolator filled with arable soil; the drainage is therefore naturally larger, and the evaporation less.

3.—*Composition of the Drainage-Water.*—Before giving the analyses of the drainage-water obtained from the drain-gauges, it will be well to mention the previous manuring of the soil, and what is known respecting its composition. The soil forming the drain-gauges was previously to 1870 under ordinary arable

cultivation. In 1870 the soil was bare fallow, save that two rows of barley (manured with guano) were sown by mistake along one end of each of the plots afterwards isolated as drain-gauges. In 1869 the crop was wheat unmanured. In 1868 swedes were grown with guano and superphosphate. The few crops immediately preceding the swedes were all cereals, grown with artificial manures, generally with guano.

The soil was sampled to the depth of 54 inches, while lying as bare fallow in June 1870. The amount of nitrogen found in each successive 9 inches of dry soil, stones removed, was as follows:—

TABLE XXVI.—NITROGEN found in the SOIL of the DRAIN-GAUGES.

Depth.	Nitrogen per cent. in Soil dried at 212°.	Nitrogen in lbs. per Acre.
First 9 inches	0·1463	3499
Second 9 „	0·0781	2083
Third 9 „	0·0757	1902
Fourth 9 „	0·0757	1825
Fifth 9 „	0·0611	1668
Sixth 9 „	0·0569	1359
Total 54 inches ..	..	12,336

The surface-soil was apparently rather richer in nitrogen than the ordinary arable soil of the Rothamsted farm, the first 9 inches of which usually contains about 0·135 per cent.

Besides the constituents originally present in the soil we must bear in mind that it annually receives from the atmosphere a certain quantity of matter in the form of rain-water, and also by its own direct absorption. Sulphates and chlorides, with smaller quantities of organic matter, ammonia, and nitrates, are thus regularly supplied. As a large portion of the rain-water is evaporated after falling on the soil, we should expect to find in the drain-water some of the constituents of the rain in increased proportion; and this is actually the case when, as in the present instance, no crop is growing upon the soil. The large amount of nitrates found in drainage-water has, however, a source far more prolific than that furnished by rain.

That nitrates are actually formed in surface soils, and fre-

quently in considerable quantity, has been long known, the saltpetre of India is indeed produced in this manner. It is only, however, during the last few years that the mode in which nitrification takes place has been clearly ascertained. Nitrification is the work of a living ferment contained in the soil, which is capable of oxidising ammonia, and probably other nitrogenous bodies, into nitric acid; the action is, in fact, quite similar to that of the vinegar ferment, which oxidises alcohol into acetic acid. The investigation establishing this fact we owe to MM. Schloesing and Müntz; their results have been amply confirmed by experiments made at Rothamsted.*

The nitrifying ferment is apparently present in all fertile soils; it requires for its activity a sufficient supply of water and air, and also some salifiable base, as chalk; a certain degree of warmth is also necessary. No nitrification will take place in a dry soil; the production of nitrates will increase in activity as the soil becomes wetter up to the point at which the water begins to interfere with the free aëration of the soil. Nitrification is at a standstill near the freezing-point, and gradually increases in activity as the temperature rises, reaching its maximum of energy about 98° Fahr. (37° C.). At a higher temperature it diminishes in activity, and ceases altogether at 131° (55° C.). The process of nitrification is probably chiefly confined to the surface soil, where nitrogenous matters are most abundant, and the supply of air greatest: it will proceed with greatest energy in summer time, and be especially active during a wet summer. The nitrate produced in soil is chiefly nitrate of calcium.

When rain-water falls upon a soil it dissolves some of the ingredients which the soil contains, and these dissolved matters finally appear to a greater or less extent in the drainage-water. The substances dissolved by rain may be divided into two classes—1. Substances freely diffusible within the soil; 2. Substances for which soil exerts more or less attraction, and which are therefore not freely diffusible. The acids freely diffusible are hydrochloric, nitric, and to a less extent sulphuric acid. The most readily diffusible bases are soda and lime. The chlorides and nitrates of sodium and calcium, and, to a less extent, the sulphates, are thus readily diffusible salts, and may be easily extracted from a soil if sufficient water be applied. On the other hand, most fertile soils possess a great retentive power for phosphoric acid, ammonia, and potash, and these substances are consequently only found in drainage-waters in minute quantity, except under very special circumstances. In the case of such

* Schloesing and Müntz's investigations will be found in the *Comptes Rendus*, lxxxiv. 301; lxxxv. 1018; lxxxvi. 892; lxxxix. 891, 1074; and the Rothamsted Papers in the *Jour. Chem. Soc.* 1878, 44; 1879, 429.

substances the small solvent action of rain results rather in their more equable distribution throughout a limited area of soil than in their removal from it.

The behaviour of rain towards the diffusible salts contained in a soil may be illustrated by some percolation experiments recently carried out in the Rothamsted Laboratory. The percolator used consisted of a large glass bottle from which the bottom had been removed; the bottle was fixed in an upright position, mouth downwards. A disk of copper gauze, covered by a disk of filter-paper, was laid inside the bottle at the lower end, and upon this 7 lbs. of a finely-powdered, air-dried, arable soil from one of the Rothamsted fields. The soil was well shaken in, so as to lie as compactly as possible. The column of soil thus obtained was about 8 inches in height, and $4\frac{1}{2}$ inches in diameter. Pure water was then poured on the surface of the soil, while the neck of the percolator was connected with an air-pump (an ordinary Bunsen filter-pump was employed) to draw away the air contained in the dry soil, and thus allow the water to descend without disturbing the coherence of the column. Without this precaution it was found that the air escaped upwards through the water, forming channels in the soil. In $2\frac{1}{4}$ hours from the application of the water the whole column was saturated, and dropping commenced. The drainage-water was collected in successive portions, and analysed with the following results:—

TABLE XXVII.—The AMOUNT and COMPOSITION of the DRAINAGE-WATER obtained in SUCCESSIVE EXTRACTS from an ARABLE SOIL.

Water put on. Grams.	Drainage-Water. Grams.	Composition of Drainage-Water. Chlorine. Per Million.	Chlorine. Grams.	Nitrogen as Nitric Acid. Per Million.	Nitrogen as Nitric Acid. Grams.
1000	50	1068·5	0·05343	188·3	0·00942
	50	266·0	0·01330	82·7	0·00414
	50	21·3	0·00106	8·0	0·00040
100	100	none	none	1·7	0·00017
1100	250	..	0·06779	..	0·01413

The effect of the rapid percolation of water through a dry soil, free from cracks and fissures, is certainly very remarkable. From the 7 lbs. of soil experimented on more than three-quarters of the diffusible salts are removed in the first 50 cubic centimetres

(about $1\frac{3}{4}$ fluid oz.) of drainage-water, and almost the whole amount of the diffusible salts is obtained in the first 150 cubic centimetres of drainage-water. The column of water passing through the soil thus evidently dissolved the chlorides and nitrates at its lower edge, and kept pushing this solution before it as a narrow layer, which was finally expelled in the first portions of the drainage-water.

To obtain this expulsion of the diffusible salts in so small an amount of drainage-water it is essential that the soil should be dry, and that the percolation of the water should take place rapidly. The experiment just quoted was intentionally aided by the air-pump, and was completed in less than 4 hours. Another experiment will illustrate what may be expected to take place when these conditions are altered.

A column of soil similar to that just described was first exhausted of its own chlorides by the passage of water through it; 0·3843 gram of pure chloride of sodium (equal to 334 lbs. per acre) was then dissolved in a little water, and poured on the surface of the saturated soil; after standing a week, percolation was commenced, 120 cubic centimetres of water being placed each day on the surface, and about the same amount of drainage-water removed below. For the percolation of this amount of water without the aid of the air-pump nearly 24 hours were required. The results were as follows:—

TABLE XXVIII.—RESULTS of PERCOLATION after CHLORIDE of SODIUM had been applied to the SOIL.

Water put on.	Drainage obtained.	Chlorine in Drainage-Water.	
		Per Million.	Grams.
Grams.	Grams.		
120	117·1	none	none
120	119·4	none	none
120	115·1	none	none
120	120·2	43·8	0·00527
120	115·3	202·0	0·02329
120	118·9	476·0	0·05659
120	114·0	621·0	0·07079
120	123·4	425·0	0·05245
120	118·9	158·0	0·01879
120	120·0	39·8	0·00478
120	119·4	7·6	0·00091
1320	1301·7	..	0·23287

The common salt applied contained 0·23313 gram of chlorine; it will be seen that practically the whole of this was recovered in the drainage-waters.

The chief cause of difference between this and the former experiment is the far greater activity of diffusion in the present instance. The chlorides when applied in solution to the wet soil began to spread downwards, though no drainage was taking place, and at the end of a week had made such progress that four days of percolation sufficed to bring chlorides into the drainage-water. That this early appearance of chlorides was due to their previous downward diffusion is proved by the small application of water at the surface necessary to cause this appearance. Had the chlorides remained at the surface it would have required the application of 850 grams of water to cause their expulsion, this being the amount of water necessary to displace the water already held by the soil; but in fact the chlorides began to appear when only 480 grams of water had been applied. Nor was there only downward diffusion; upward diffusion was also active during the 11 days of percolation; and consequently the layer of water richest in chlorides was followed by a considerable amount of drainage containing chlorides in gradually diminishing proportion. The nett result of the 18 days' diffusion was that it required 1320 grams of water to expel the chlorides from the soil, whereas the chlorides were expelled by only 1000 grams of water in the previous speedy percolation. The chlorides are now also distributed throughout 690 grams of drainage-water, whereas previously the whole was contained in 150 grams.*

We see from these experiments that the expulsion of the diffusible salts from a soil is effected most readily when the percolation is rapid; that consequently a heavy rainfall, occurring in a few days, is far more dangerous in this respect than the same rainfall spread over a month. We see also that but for the action of diffusion, and other causes tending in the same direction, the soluble salts contained in a soil would descend on the application of rain in a well-defined band, and be suddenly discharged in the drainage-water; whereas in fact the diffusion always going on in a moist soil tends to distribute the chlorides and nitrates equally throughout the mass of soil, and thus produces a considerable uniformity in the composition of the drainage-water. Evidence of the existence of bands of saline solution in the soil will, however, be found when we

* The tardy expulsion of the chlorides from a wet soil was probably determined in part by other causes besides diffusion, but the view given in the text will suffice for our present purpose.

have, by and bye, to consider the drainage-waters obtained from manured land.

A word must next be said on some percolation experiments in which nitrate of sodium was applied to the soil; these illustrate afresh the facts just pointed out, and at the same time exhibit some special relations of nitrates with soil, which we shall do well to bear in mind. The first experiment was strictly comparative with that made with chloride of sodium just described; the two experiments were indeed conducted side by side, and in precisely the same manner. The quantity of pure nitrate of sodium employed was 0·5588 gram (equal to 519 lbs., or 80 lbs. of nitrogen, per acre), the exact chemical equivalent of the chloride of sodium used in the comparative experiment. The saturated soil was allowed to stand for a week after the application of the nitrate; successive quantities of water were then placed on the surface, and the drainage-water obtained collected and analysed, yielding the following results:—

TABLE XXIX.—RESULTS of PERCOLATION after NITRATE of SODIUM had been applied to the SOIL.

Water put on. Grams.	Drainage obtained. Grams.	Nitrogen as Nitrates and Nitrites in Drainage-Water.	
		Per Million.	Grams.
120	116·4	none	none
120	118·7	none	none
120	97·0	none	none
120	134·0	none	none
120	126·3	9·0	0·00114
120	120·4	57·3	0·00690
120	120·6	72·6	0·00876
120	117·2	20·0	0·00234
120	118·9	0·5	0·00006
1080	1069·5	..	0·01920

It was observed in making the third extract that the water had begun to percolate more slowly than in the experiment in progress at the side with chloride of sodium; this resistance to the passage of water increased, so that by the fifth extract the percolation of 120 cubic centimetres of water occupied twice the time required in the experiment with chloride of sodium. The cause of this retardation was quite apparent; large transverse cracks, filled with gas, had formed in the soil, the largest being two or three inches from the surface; no such cracks appeared in the chloride of sodium percolator.

On turning to the analyses of the drainage-water, we see that nitrates did not begin to appear until the fifth extract, that they

reached their maximum in the seventh extract, and were all removed at the ninth. The nitrates thus appeared later than the chlorides, and ceased sooner; the nitrates were spread over five extracts, while the chlorides occupied eight. Nitrites were found in the drainage-water.

The whole of these facts find their explanation when we look at the quantity of nitrate recovered in the drainage. The nitrate of sodium employed contained 0·09198 gram of nitrogen; of this only 0·01920 gram, or 20·9 per cent., was recovered in the drainage-water. It will be recollected that in the corresponding experiment with chloride of sodium practically the whole of the chlorine was recovered. How has this serious loss of nitric acid occurred? Clearly by reduction of the nitrates in a water-logged soil, destitute of free oxygen. This reduction in question has been effected by the organic matter of the soil, and has resulted in the formation of carbonic acid gas. A part of the nitric acid has probably been reduced to ammonia, while a considerable part of the nitrogen has most likely taken the form of nitrogen gas. The soil employed was by no means rich in organic matter; but the perfect consolidation of the soil, the removal of air by the pump when water was first poured on, and the fact that the soil was always afterwards covered with water, afforded opportunity for the consumption of all available oxygen, and then for the reduction of the nitrates present. The experiment was conducted in April; the temperature was therefore not high.

To confirm these results, the soil already treated with chloride of sodium was made use of for a second experiment with nitrates. The quantity of nitrate of sodium used was double that previously employed. Instead of waiting a week after the application of the nitrate, percolation was started a few hours after its addition to the soil; less opportunity for reduction was thus afforded. The results appear in Table XXX., p. 334.

The development of cracks in the soil, the retardation of drainage, and the production of nitrites were observed as before. The nitrate of sodium employed had contained 0·18396 gram of nitrogen; of this 0·10305 gram, or 56 per cent., was recovered in the drainage-water. The absolute loss was really, however, rather larger than in the previous experiment with half the quantity of nitrate; the loss then was 0·07178 gram, while now it amounted to 0·08091 gram of nitrogen.

The reduction of the nitrates in soil to ammonia and gaseous nitrogen, when oxygen has been excluded, has been observed by Schloesing * and others; the fact is of considerable agricultural importance, as showing the loss of nitrates, and even of soil nitrogen, which may occur in ill-drained soils in wet weather.

* *Comptes Rendus*, lxxvii. 353.

TABLE XXX.—RESULTS of PERCOLATION after a DOUBLE QUANTITY of NITRATE of SODIUM had been applied to the SOIL.

Water put on. Grams.	Drainage obtained. Grams.	Nitrogen as Nitrates and Nitrites. in Drainage-Water.	
		Per Million.	Grams.
120	118·3	none	none
120	117·2	none	none
120	112·2	none	none
120	126·0	none	none
120	126·7	7·6	0·00096
120	119·9	119·3	0·01430
120	119·9	288·3	0·03457
120	119·5	294·8	0·03523
120	120·7	136·2	0·01644
120	122·4	11·9	0·00146
120	115·1	0·8	0·00009
1320	1317·9	..	0·10305

We will now turn to the composition of the drainage-waters obtained from the soils of the three drain-gauges. The first series of analyses was made by Dr. Frankland; the analyses are published in the 'Sixth Report of the Rivers' Pollution Commission, 1874,' p. 62. The results appear in Table XXXI.

Samples of the drainage-water were thus collected from all three gauges on five different occasions; on each occasion, except the last, drainage was taking place pretty freely when the collection was made.

The first collection (Nov. 20–23, 1870) was made about two months after the gauges were completed. The summer had been a very dry one. No considerable drainage had taken place before the collection of the samples; this was especially true in the case of the 40 and 60-inch gauges. The waters analysed were clear.

The second collection, December 15–17, 1870, was about a month after the first; in the interval between the two collections a moderate amount of drainage had occurred. The waters analysed were all turbid.

The third collection, Oct. 30–31, 1872, occurred about two years after the first. The preceding summer had been very dry, but between two and three inches of drainage had occurred in October before the collection of the samples. The waters were slightly turbid.

The fourth collection, February 25–26, 1873, was made under very different circumstances. The preceding four months had in this case been very wet, about 12 inches of drain-water having come through the 20-inch gauge. The waters collected arose from the melting of snow; all were turbid.

TABLE XXXI.—ANALYSES by DR. FRANKLAND of DRAINAGE-WATERS from the three DRAIN-GAUGES, 20, 40, and 60 Inches deep, in parts PER MILLION.

Date of Collection.	Total Solid Matter.	Carbon in Organic Matter	Nitrogen as Organic Matter.	Nitrogen as Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Nitrogen.	Chlorine.	Total Hardness.
SOIL 20 INCHES DEEP.								
Nov. 20–23, 1870	632·8	1·08	0·45	0·00	49·36	49·81	21·5	129
Dec. 15–17, 1870	400·4	1·84	0·64	0·00	31·76	32·40	38·0	146
Oct. 30–31, 1872	302·4	1·14	0·45	0·01	26·36	26·82	6·0	166
Feb. 25–26, 1873	180·0	1·42	0·45	0·02	6·07	6·54	9·5	120
April 2–30, 1874	274·4	1·74	0·75	0·20	21·46	22·41	9·5	137
Mean	358·0	1·44	0·55	0·05	27·00	27·60	16·9	140
SOIL 40 INCHES DEEP.								
Nov. 20–23, 1870	362·4	1·47	0·49	0·00	23·45	23·94	28·6	134
Dec. 15–17, 1870	386·0	2·35	0·82	0·00	23·89	24·71	30·0	131
Oct. 30–31, 1872	273·2	0·96	0·32	0·00	21·06	21·38	8·0	166
Feb. 25–26, 1873	192·4	1·27	0·26	0·01	7·89	8·16	9·5	97
April 2–30, 1874	230·8	1·17	0·54	0·10	16·02	16·66	9·5	120
Mean	289·0	1·44	0·49	0·02	18·46	18·97	17·1	130
SOIL 60 INCHES DEEP.								
Nov. 20–23, 1870	392·4	1·27	0·42	0·00	28·53	28·95	26·0	155
Dec. 15–17, 1870	366·8	3·71	1·16	0·21	24·89	26·26	21·5	35
Oct. 30–31, 1872	326·8	0·98	0·37	0·01	23·65	24·03	10·5	126
Feb. 25–26, 1873	223·6	1·68	0·40	0·02	7·59	8·01	9·5	104
April 2–30, 1874	264·0	0·98	0·42	0·16	17·32	17·90	9·5	130
Mean	314·7	1·72	0·55	0·08	20·40	21·03	15·4	110

The fifth collection, April 2–30, 1874, was a mixture of all the runnings during one month. Drainage was pretty continuous throughout the month, though at a very gentle rate, barely one-third of an inch having been collected from the 20-inch gauge. The preceding winter had been dry. The water from the 20-inch gauge was slightly turbid; the others were clear.

The first three collections are thus autumn drainage-waters, the preceding summers having been dry. Nitrification had doubtless been active in the upper layer of the soils during the summer months; but as very little drainage had occurred the nitrates produced had not been to any considerable extent removed by rain. These drainage-waters were consequently all of a concentrated character, and particularly rich in nitrates.

The fourth collection fell on the other hand towards the close of a remarkably wet winter, when the soil had been washed by the percolation of a large amount of water. The drainage-water now was less concentrated than before, and was especially poor in nitrates.

The fifth collection was in spring, at the end of a dry winter. The rate of drainage having been very slow, the water doubtless represented the general discharge of the soil, and owed but little to direct channel drainage. The water is seen to be much more concentrated than that obtained at the fourth collection, but does not equal in this respect the three autumn drainage-waters.

Looking at the analyses generally, we see that ammonia is either absent, or occurs in very small quantity. The amount of organic matter dissolved in the water is but small; it is increased when the water is turbid; it is in all cases highly nitrogenous. The mean ratio of organic nitrogen to carbon in the drainage-waters from the three gauges is 1 : 2·6, 1 : 2·9, and 1 : 3·1, the proportion of carbon apparently increasing with the depth of the soil. This, however, can hardly be established as a fact from the few analyses now before us. The proportion of carbon is highest in the turbid waters; the mean ratio of nitrogen to carbon in the six turbid waters being 1 : 3·3, and in the nine clear or slightly turbid waters 1 : 2·6. Turbidity in a drainage water is a sign that direct channel drainage has occurred, matter being brought immediately from the surface.

Dr. E. J. Mills has already called attention ('Trans. Chem. Soc.,' 1878, p. 64) to the constancy of the relation between the nitrogen and carbon of the organic matter found in clear well- and drainage-waters. He considers that the slow oxidation which organic matter undergoes in a soil finally reduces all forms of organic matter to a few simple compounds, in which the carbon and nitrogen have the relation $C_{12} : N_3$, $C_{12} : N_4$, or $C_{12} : N_5$; in the drainage-waters we are now considering the com-

position of the organic matter corresponds with the second of the above ratios. The gradual increase in the proportion of nitrogen contained by organic matter as oxidation in the soil proceeds, is strikingly shown by the determinations of carbon and nitrogen which have been made in the Rothamsted soils. In the surface soil (first 9 inches) of pasture land, with roots as far as possible removed, the proportion of nitrogen to carbon is about 1 : 13. In the clay subsoil of the same land (fifth and sixth 9 inches) the proportion is about 1 : 6. In the soluble organic matter contained in drainage-water we have just seen that the proportion reaches 1 : 2·6. Respecting the nature of these nitrogenous organic bodies, and the part they possibly play in plant nutrition, very little is at present known.

The chlorides found in the first two analyses greatly exceed in amount any quantity subsequently found; this large proportion of chlorides was probably due to the previous manuring with guano. The amount of lime present in the waters was considerable, as shown by the "hardness." In the later analyses the total solid matter is chiefly made up of calcium salts—nitrate, sulphate, and carbonate; alkali salts must, however, have been also present in considerable quantity. In the earlier samples, the alkali salts form the largest ingredient; at least the calcium salts can account for only a small part of the solid matter.

If we compare together the drainage-waters from the three gauges, we see that as far as the total solid matter and nitrates are concerned, the drainage from the 40-inch gauge is weaker than from either of the others, the order of strength is in fact 20, 60, 40. This comparatively low proportion of nitrates in the drainage from the 40-inch gauge is shown in the first analysis made in 1870, and is equally shown in nearly all the analyses that have been made since; the cause must apparently be sought in some original difference in the soil forming this gauge.

We pass now to the more recent analyses of these drainage-waters. Since September, 1874, a sample has been taken from the drainage of each day, and mixed monthly samples prepared representing the drainage from each gauge. It being uncertain whether the samples could be analysed, the sampling was at first roughly done; but since May, 1877, a fixed fraction of each day's running has been carefully taken, so that the mixed monthly sample might exactly represent the whole drainage. The earlier samples were not examined till the spring of 1877, owing to the lack of analytical assistance in the Laboratory. At that time many of the samples were found to be ill preserved, and had to be discarded; determinations of nitric acid were then made in the remainder. Since May, 1877, determinations

of nitric acid and of chlorine have been made as soon as possible after the completion of the monthly sample. It is obvious that the analyses of the earlier samples do not possess the same quantitative value as those more recently done; we shall give, however, in a separate table (XXXII.) the amounts of nitrogen as nitric acid found in the best preserved samples in the earlier series, as they serve to illustrate some facts connected with these drainage-waters. The nitric acid has in all cases been determined by the improved indigo method ('Trans. Chem. Soc.,' 1879, p. 578), and the chlorine by the volumetric method already noticed.

TABLE XXXII.—NITROGEN as NITRIC ACID in some MIXED MONTHLY SAMPLES of DRAINAGE-WATER from the three DRAIN-GAUGES, 1874–77.

MONTHS.	Drainage in Inches.			Nitrogen as Nitric Acid per Million of Water.		
	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.
1874.						
September	0·634	0·249	0·212	25·5	20·0	15·1
October	1·525	1·258	1·024	39·6	30·5	22·5
November	1·209	1·045	0·687	..	..	20·0
December	1·155	1·340	1·039	..	..	23·2
1875.						
June	0·349	0·262	0·140	25·1	23·5	22·5
July	3·292	3·661	3·346	26·1	21·6	22·8
August	0·001	0·025	0·030	..	20·9	23·8
September	0·890	0·829	0·707	38·3	26·7	25·9
1876.						
March	1·283	1·745	1·585	9·3	10·9	14·6
April	1·360	1·664	1·720	..	11·5	12·2
August	0·146	0·141	0·025	22·0	18·7	..
September	2·296	2·236	2·041	25·2	..	19·8
December	5·212	5·741	5·252	9·8	10·0	11·5
1877.						
January—April ..	7·003	8·467	7·930	8·1	9·1	12·0

The drain-gauges did not run during June and July 1876, and to a scarcely appreciable extent in May of the same year.

Two facts are pretty clearly shown by these somewhat disconnected determinations. 1. That the maximum richness in nitrates occurs in the early autumn drainage, the proportion diminishing through the winter, and reaching a minimum in

spring. 2. That in early autumn the drainage from the 20-inch gauge is richest in nitrates, but that in late winter and spring the drainage from the 60-inch gauge becomes generally the richest. These two facts will be found further illustrated by the more recent analyses contained in Table XXXIV. (p. 346); they admit of ready explanation. The summer, as already mentioned, is the season when nitrates are most abundantly produced in the surface soil; but little drainage occurs in summer time, owing to the high rate of evaporation; the nitrates therefore accumulate in the soil. In the autumn drainage becomes active, and the washing-out of the nitrates commences; the first drainage is not, however, always the strongest, as the nitrates are most abundant at the surface, and must be displaced by rain, and allowed time for diffusion before they can appear in quantity in the drainage-water. The drainage from the shallowest soil is the first to show a maximum contents of nitrates, because the amount of displacement and diffusion required to bring the nitrates within the area of discharge is here the smallest; for the very same reason the shallowest soil is also the most quickly washed out, while the deepest soil, having a larger mass available for the diffusion of the nitrates, parts with them more equably.

Before considering the more complete series of monthly analyses, extending from May, 1877, to the present time, it will be convenient to give the results obtained in March and April, 1879 (Table XXXIII.), when a detailed examination was made of the runnings from the 60-inch gauge, as these results will help to interpret the remainder.

The winter of 1878–9 had been extremely wet, and the drainage collected up to the middle of February far exceeded the normal quantity. March, however, was dry, so that the drain-gauges almost ceased running, and it was necessary in the present case to allow the drainage-water to accumulate for two or three days in order to obtain sufficient for analysis. The rain credited to March 24–26 was really snow, which, having thawed, was measured on the last of these days. The snow on the soil of the drain-gauge would melt later. In April the amounts of rain and drainage were much more considerable.

The analyses of the drainage-waters during March display a considerable amount of uniformity. The more considerable rains, namely, those of the 10th, 14th, 26th, and 30th, do not, except in the last instance, appreciably increase the amount of drainage, but they have all a more or less distinct effect in temporarily diminishing the proportion of nitrates in the drainage-water.

The results obtained in April, with greater rainfalls, are much more striking. Here, as before, small rainfalls, as those of the

TABLE XXXIII.—NITROGEN AS NITRATES IN DRAINAGE-WATERS, from the 60-INCH DRAIN-GAUGE in MARCH and APRIL, 1879.

Date.	Rain. Inches.	Drainage. Inches.	Nitrogen as Nitrates per Million.	Date.	Rain. Inches.	Drainage. Inches.	Nitrogen as Nitrates per Million.
March 1	..	0·091	14·2	April 1	..	0·013	15·8
,, 2	0·016			,, 2	0·009	0·009	15·5
,, 3	0·056	0·017	14·6	,, 3	0·180	0·010	10·8
,, 4	0·015	0 015	14·4	,, 4	0·008	0·008	14·9
,, 5	0·038	0·014	13·2	,, 5	0·060	0·238	8·1
,, 6	0·004	0·015	14·8	,, 6	0·532		
,, 7	0·005			,, 7	0·094	0·153	11·3
,, 8	0·008	0·014	15·3	,, 8	..	0·045	13·7
,, 9	0·005			,, 9	0·204	0·021	12·5
,, 10	0·133	0·014	14·9	,, 10	0·054	0·036	13·9
,, 11	..			,, 11	0·003	0·018	15·4
,, 12	..	0·011	15·0	,, 12	0·138	0·282	10·3
,, 13	0·008			,, 13	0·418		
,, 14	0·153	0·011	13·9	,, 14	0·192	0·067	12·2
,, 15	0·005			,, 15	0·204	0·114	12·3
,, 16	0·006	0·009	14·7	,, 16	..	0·103	12·3
,, 17	..			,, 17	0·100	0·027	14·0
,, 18	0·030	0·011	15·0	,, 18	0·005	0·013	14·6
,, 19	..			,, 19	0·156	0·024	7·2
,, 20	..			,, 20	0·152	0·045	9·6
,, 21	0·039	0·007	15·9	,, 21	0·004	0·028	14·8
,, 22	..			,, 22	0·027	0·017	14·6
,, 23	..			,, 23	0·156	0·029	7·0
,, 24	0·156	0·004	16·6	,, 24	0·005	0·014	14·0
,, 25				,, 25	0·111	0·016	13·4
,, 26				,, 26	0·012	0·015	14·6
,, 27	..	0·007	10·4	,, 27	0·020	0·012	14·6
,, 28	0·080			,, 28	0·002	0·007	15·0
,, 29	0·083			,, 29	0·010	0·006	15·1
,, 30	0·250	0·017	11·9	,, 30	0·025	0·006	15·3
,, 31	0·094			..	..	..	..
Whole Month	1·184	0·257	14·2	Whole Month	2·791	1·376	11·2

3rd, 9th, 19th, 20th, 23rd, and 25th, have a very slight effect on the amount of drainage, but each of them temporarily diminishes the nitrates in the drainage-water, in some cases to less than half their usual quantity. Larger rains, as those of the 6th and 13th, increase the quantity of drainage as well as diminish the proportion of nitrates.

A study of these results plainly shows that the dry weather and wet weather drainages from the soil were quite distinct in composition. In dry weather a small discharge took place from the lowest layer of the 5 ft. of soil, which alone remained saturated; this drainage-water contained pretty uniformly during the period of the experiment about 15 parts of nitrogen

per million in the form of nitrates. When a small rainfall occurred the quantity of the discharge was scarcely increased, but it became considerably diluted, the drainage from the lowest layer of soil being now mixed with rain-water, which had come through open channels directly from the surface. With a heavier rain, pressure was brought to bear on the water column in the soil, and the discharge from the lowest layer was then much increased, but diluted as before with direct channel water.

Another experiment of the same character may be quoted. The drainage from the 20-inch and 60-inch gauges was collected both on the morning and evening of January 14th, 1879; between the two collections a thaw of snow had taken place. The nitrogen existing as nitric acid per million of water was as follows:—

	20-Inch Gauge.	60-Inch Gauge.
Morning Collection ..	8·4	12·7
Evening Collection ..	5·7	6·3

We have, therefore, to bear in mind that the strongest drainage-waters are those obtained after rain has ceased; and that the composition of the drainage-water may be considerably influenced by the varying amount and distribution of the rain; the rain applied to the surface of a soil not simply displacing the water below, but in part proceeding directly to the area of discharge through the open channels of the soil.

The results of the analyses of the mixed monthly samples of drainage-water since May 1877 will be found in Table XXXIV. (p. 344). The amounts of monthly drainage there given will be found in a few cases not to correspond with those found in Table XIX. (p. 272). Thus the amounts credited to the 40- and 60-inch gauges in April 1878, and to the 20-inch gauge in February 1879, are in excess of the numbers previously given. The quantities now stated are the actual amounts of drainage passing through the soil; but, as already explained (p. 271), they are known to be excessive in these particular cases from accidental circumstances, and were therefore corrected in the earlier table. Such corrections are here, however, inadmissible, as our object is to ascertain the total quantity of nitric acid extracted from the soil. In the case of August 1879, the quantity of drainage-water sampled for analysis from all the gauges was less, and in the case of the 60-inch gauge much less, than

that quoted in the table; owing to the loss of part or all the water belonging to the storm of August 2–3. The determinations of nitrates and chlorides for this month are consequently somewhat above the truth, the water analysed being stronger than the whole drainage of the month; the error will be least with the 20-inch and most with the 60-inch gauge.

In January 1880, we were disagreeably surprised by finding a large worm come through the tap of the measuring cylinder of the 20-inch gauge. On testing the drainage-waters for ammonia a considerable quantity was found in the water from this gauge, and a small quantity in that from the 60-inch gauge, but none in that from the 40-inch gauge. The fronts protecting the funnels were then taken down. A number of dead worms were found on the funnel of the 20-inch gauge, and many worm casts dropped from the perforations in the roof. On the funnel of the 60-inch gauge two worms were found. The funnel of the 40-inch gauge was clean. The whole of the funnels and collectors were thoroughly cleaned. Since this time a careful examination of the funnels has been made on the first day of each month. In seventeen months one or more small worms have four times been found on the funnel of the 20-inch gauge, and worm casts on seven occasions. On the funnel of the 40-inch gauge a worm was found twice, and a slug three times. The funnel of the 60-inch gauge has remained uniformly clean. The ammonia in the waters disappeared immediately after the cleansing of the funnels in January.

The fact that the drainage-water from two of the gauges was at one time plainly contaminated with decaying animal matter naturally suggests a doubt as to the nitric acid determinations in these waters. Has the nitric acid found been due to any considerable extent to the nitrification of this animal matter?—and are the quantities of nitric acid consequently higher than those of normal drainage-water? We believe that the considerable invasion of worms during the early winter of 1879–80 was a special occurrence, the severity of the frost causing the worms to descend further than usual in the soil. The drainage-waters had been tested frequently for ammonia (by direct application of the Nessler test) both before and after this occurrence, but always with negative results. Again, during the last seventeen months in which the funnels and collectors have been kept as clean as possible, the amounts of nitric acid found have not shown any diminution; indeed, during September 1880 a larger quantity of nitric acid was obtained in the drainage than in any preceding month as yet recorded. While, therefore, it seems possible that the nitric acid found in the drainage-water of the 20-inch gauge may have been rather abnormally high during the

winter of 1879-80, we are not disposed to think that the general bearing of the results has been disturbed by the occasional presence of worms. It must also be recollected that animal life is present in all soils, indeed, often to a far greater extent than is usually imagined, and that the nitrification of the ammonia resulting from decaying animal matter is therefore not an abnormal occurrence, but one of the ordinary sources of the nitric acid in drainage-water.

We have just stated that ammonia is not a usual constituent of the drainage-water from the gauges. The waters have also been from time to time examined for nitrous acid, but nothing beyond a minute trace has ever been found. The process of nitrification in the soil is clearly very complete.

Turning now to the determinations contained in Table XXXIV. (p. 344) we shall at once remark the much lower amount of nitric acid contained in the drainage from the 40-inch gauge, as compared with that found in the drainage from the other gauges. Taking the average composition of the whole amount of drainage from the three gauges during forty-eight months, we have for the 20-inch gauge, 11·8; for the 40-inch gauge, 8·9; and for the 60-inch gauge, 11·5 parts of nitrogen as nitrates per million of water. This considerable deficiency of nitrates in the drainage from the 40-inch gauge is apparent in Frankland's earliest analyses of these drainage-waters; it is probably, therefore, due to some original difference in the composition of the soils. No such difference is perceived in the proportion of chlorides contained in the three drainage-waters, which average 3·9, 3·9, and 3·8 parts of chlorine per million.

There is not much regularity of sequence visible in the proportion of nitrates and chlorides found from month to month in the drainage-waters, and still less in the weights of nitrogen and chlorine removed monthly from the soil in this manner. The conditions suitable for nitrification—the temperature and humidity of the soil, have varied extremely; the monthly amounts of drainage have varied quite as much. Both the production and removal of nitrates have thus proceeded very irregularly. A reference to Table XV. will show that the supply of chlorides in the rain has been equally irregular. The series is too short for these irregularities to disappear by taking an average of the monthly results; we must, therefore, confine our attention to a few principal points.

The two facts we have already pointed out in the earlier results find here fresh illustration; thus the drainage-waters are seen to be generally richest in nitrates from July to October, and poorest from April to June. The extremely wet and cold summer of 1879 forms an exception; the waters did not here

TABLE XXXIV.—AMOUNT of NITROGEN as NITRATES, and of CHLORINE,

	Amount of Drainage.			Nitrogen as Nitrates per Million of Water.		
	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.
1877.	Inches.	Inches.	Inches.			
May	0·445	0·548	0·510	11·5	10·3	15·2
June	0·026	0·096	0·102	8·1	8·2	14·2
July	0·560	0·514	0·440	20·3	15·0	19·6
August	0·384	0·387	0·313	29·5	17·5	21·7
September	0·205	0·254	0·207	25·4	15·5	21·0
October	0·580	0·505	0·389	30·9	18·6	23·4
November	4·031	4·201	3·824	12·5	11·5	12·7
December	1·742	1·982	1·752	12·4	10·9	14·3
Total 8 Months ..	7·973	8·487	7·537	15·4	12·3	14·8
1878.						
January	1·101	1·362	1·200	13·0	11·1	15·4
February	1·013	1·203	1·132	10·5	8·9	11·7
March	0·273	0·503	0·458	13·2	9·5	14·9
April	2·349	2·822	3·467	6·6	6·3	7·6
May	1·479	1·848	1·502	13·3	9·8	14·0
June	0·611	0·856	0·755	13·3	9·9	13·8
July	0·009	0·032	0·063	11·5	10·7	13·3
August	1·331	1·169	1·129	23·0	13·8	16·9
September	0·075	0·122	0·113	17·9	11·2	16·5
October	1·370	1·391	1·103	18·6	14·0	16·6
November	3·771	4·067	3·665	11·1	9·7	11·5
December	1·108	1·374	1·542	12·0	8·3	11·8
Total 12 Months ..	14·490	16·749	16·129	12·8	9·8	12·2
1879.						
January	2·470	2·652	2·472	11·8	7·7	11·2
February	5·734	4·438	4·218	7·2	6·9	9·2
March	0·138	0·284	0·257	15·2	7·7	14·1
April	1·270	1·508	1·375	12·2	7·4	11·2
May	1·217	1·393	1·297	9·5	6·3	9·9
June	2·156	2·239	2·185	8·3	5·8	9·3
July	1·828	1·965	1·806	11·0	7·9	11·4
August	4·601	4·598	4·346	9·3	7·0	11·4
September	1·110	0·998	0·920	2·8	9·2	13·3
October	0·221	0·422	0·426	12·7	9·3	13·2
November	0·195	0·116	0·099	16·2	9·0	13·6
December	0·413	0·490	0·442	16·5	8·3	12·1
Total 12 Months ..	21·353	21·103	19·843	9·7	7·2	10·8
1880.						
January	0·482	0·611	0·457	15·4	9·7	14·2
February	2·360	2·591	2·301	17·7	11·3	12·9
March	0·038	0·095	0·085	15·4	8·8	12·9
April	0·493	0·533	0·434	16·7	10·5	14·2
May	0·002	0·021	0·028			
June	0·010	0·008	0·020	21·9	12·7	16·0
July	1·352	1·229	1·062			
August	0·214	0·279	0·221	21·6	11·2	15·8
September	3·964	3·931	3·779	17·8	13·1	12·5
October	4·466	4·448	4·070	12·8	9·2	10·8
November	2·244	2·387	2·141	10·4	7·8	10·9
December	2·814	2·852	2·681	7·1	6·9	9·4
Total 12 Months ..	18·439	18·985	17·279	14·3	10·1	11·8
1881.						
January	1·013	1·121	1·321	3·0	4·5	6·6
February	3·426	3·707	3·287	4·8	4·9	7·4
March	1·663	1·779	1·654	3·9	4·5	6·6
April	0·003	0·010	0·030	..	6·3	12·1
Total 4 Months ..	6·105	6·617	6·292	4·3	4·7	7·0
Total 48 Months ..	68·360	71·941	67·080	11·8	8·9	11·5
Average 12 Months	17·090	17·985	16·770	11·8	8·9	11·5

in the Monthly Drainage-Waters from the Three Drain-Gauges.

Nitrogen as Nitrates per Acre.			Chlorine per Million of Water.			Chlorine per Acre.		
20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.	20-Inch Gauge.	40-Inch Gauge.	60-Inch Gauge.
lbs.	lbs.	lbs.				lbs.	lbs.	lbs.
1·16	1·28	1·75	12·7	4·7	5·0	1·28	0·58	0·58
0·05	0·18	0·33	..	4·0	5·7	..	0·09	0·13
2·57	1·74	1·95	5·9	5·7	5·3	0·75	0·66	0·53
2·56	1·53	1·54	7·3	6·3	6·3	0·63	0·55	0·45
1·18	0·89	0·98	6·6	6·0	6·0	0·31	0·34	0·28
4·06	2·13	2·06	10·0	8·1	9·0	1·31	0·93	0·79
11·40	10·93	10·90	5·0	5·6	5·3	4·56	5·32	4·59
4·89	4·89	5·67	5·3	5·2	4·5	2·09	2·33	1·78
27·87	23·57	25·27	6·1	5·6	5·4	10·93	10·80	9·13
3·24	3·42	4·18	5·0	5·0	5·0	1·25	1·54	1·36
2·41	2·42	3·00	4·0	4·1	4·0	0·92	1·12	1·02
0·82	1·08	1·54	4·7	4·4	4·6	0·29	0·50	0·48
3·51	4·02	5·96	3·1	3·3	3·0	1·65	2·11	2·35
4·45	4·10	4·76	3·7	3·7	3·6	1·24	1·55	1·22
1·84	1·92	2·36	4·0	4·5	4·0	0·55	0·87	0·68
0·02	0·08	0·19	4·0	5·4	3·9	0·01	0·04	0·06
6·93	3·65	4·32	4·5	4·9	4·7	1·36	1·30	1·20
0·30	0·31	0·42	4·6	4·8	4·8	0·08	0·13	0·12
5·77	4·41	4·14	4·9	5·1	5·3	1·52	1·61	1·32
9·47	8·93	9·54	3·8	4·3	4·1	3·24	3·96	3·40
3·01	2·58	4·12	4·1	4·1	3·8	1·03	1·27	1·33
41·77	36·92	44·53	4·0	4·2	4·0	13·14	16·00	14·54
6·59	4·62	6·26	2·8	3·7	3·3	1·56	2·22	1·85
9·34	6·93	8·78	4·5	3·6	3·4	5·84	3·61	3·24
0·47	0·49	0·82	3·6	3·7	4·0	0·11	0·24	0·23
3·51	2·53	3·48	3·9	3·9	3·7	1·12	1·33	1·15
2·62	1·99	2·91	4·2	3·6	3·8	1·16	1·13	1·12
4·05	2·94	4·60	2·9	3·1	3·0	1·41	1·57	1·48
4·55	3·51	4·66	3·4	3·8	3·6	1·41	1·69	1·47
9·68	7·28	11·21	1·3	2·2	2·7	1·35	2·29	2·66
3·21	2·08	2·77	2·2	2·8	3·4	0·55	0·63	0·71
0·64	0·89	1·27	2·7	3·0	3·3	0·14	0·29	0·32
0·71	0·24	0·30	3·7	4·2	4·1	0·16	0·11	0·09
1·54	0·92	1·21	4·8	4·2	3·2	0·45	0·47	0·32
46·91	34·42	48·27	3·2	3·3	3·3	15·26	15·58	14·64
1·68	1·34	1·47	3·0	3·6	3·9	0·33	0·50	0·40
9·45	6·62	6·72	4·0	4·0	4·0	2·14	2·34	2·08
0·13	0·19	0·25	4·5	3·8	5·0	0·04	0·07	0·10
1·86	1·27	1·39	3·9	3·9	3·9	0·44	0·47	0·38
6·76	3·61	4·02	4·9	4·3	4·5	1·51	1·22	1·13
1·05	0·71	0·79	4·8	4·3	3·8	0·23	0·27	0·19
15·96	11·65	10·69	3·0	3·6	2·9	2·69	3·20	2·48
12·93	9·26	9·95	3·3	3·1	3·2	3·33	3·12	2·95
5·28	4·21	5·28	3·9	3·8	4·0	1·98	2·05	1·94
4·52	4·45	5·70	3·4	3·6	3·5	2·16	2·30	2·12
59·62	43·31	46·26	3·6	3·6	3·5	14·85	15·54	13·77
0·69	1·14	1·97	4·8	4·2	4·2	1·10	1·07	1·26
3·72	4·11	5·50	3·8	4·2	4·0	2·95	3·52	2·97
1·47	1·81	2·47	3·9	3·9	3·7	1·47	1·57	1·38
..	0·01	0·08	..	3·0	3·7	..	0·01	0·03
5·88	7·07	10·02	4·0	4·1	4·0	5·52	6·17	5·64
182·05	145·29	174·35	3·9	3·9	3·8	59·70	64·09	57·72
45·51	36·32	43·59	3·9	3·9	3·8	14·93	16·02	14·43

show a high proportion of nitrates at the usual period of maximum; while in the dry autumn and winter which followed the proportion of nitrates is for the season unusually high.

We have evidence again of the greater relative richness of the drainage from the 20-inch gauge during the season of maximum proportion of nitrates, and its relative poverty, as compared with the water from the deepest gauge, as the season of minimum nitrates approaches. This gradual change of relation between the waters of the 20-inch and 60-inch gauges is most conspicuously seen in the autumn and winter of 1877–78, and of 1880–81. It follows from what has just been stated that the range in composition is greatest in the water from the 20-inch gauge, less in that from the 40-inch gauge, and least in that from the 60-inch gauge. At a still greater depth the drainage-water would probably have a uniform composition all the year round.

The quantity of nitrates removed in the autumn drainage-waters is generally greater than at any other period of the year, the drainage-waters being most concentrated at this season, and the drainage also usually abundant. This excess during autumn is most marked in the drainage from the shallowest soil. Thus with the 20-inch gauge the nitrates removed during the last six months of the year have been on an average 65·3 per cent. of the annual quantity; with the 40-inch gauge, 62·6 per cent.; and with the 60-inch gauge, 59·5 per cent. The amount of drainage for the same period being respectively 56·4, 55·2, and 54·5 per cent.

The effect of a heavy and continuous rain in removing exceptionally large quantities of nitrates from the soil is strikingly shown by the results obtained in September 1880. In this month 5·110 inches of rain fell at Rothamsted in five days, and the quantity of nitrogen as nitrates in the drainage-water from the 20-inch gauge amounted to nearly 16 lbs. per acre, an amount far larger than that obtained in any other month during the four years. This is quite in accordance with what has been already said (page 331). A heavy rain, falling in a short time, should be especially effective in discharging the soluble salts from a soil, as the smallest opportunity is then afforded for the retention of the salts through upward diffusion within the wet soil.

The proportion of chlorides in the drainage-waters shows far less range of variation than that of nitrates. The chlorides present in these soils being derived from the rain are not, like the nitrates, produced chiefly at one season of the year, but are supplied whenever a shower falls. Small rainfalls, we have already seen, are richer in chlorides than large rainfalls, and

the rain of winter is richer than that of summer. The winter drainage contains a larger proportion of chlorides than the summer drainage; and a maximum proportion of chlorides is sometimes reached towards the end of winter. The maximum, however, generally occurs towards the end of summer, or the beginning of autumn, the great evaporation of rain from the soil during summer storing up chlorides in a more than usually concentrated form. In a cold and wet summer, like that of 1879, this period of maximum is not perceptible.

If we look at the quantities of chlorine removed by the drainage-waters per acre of soil, we shall find a pretty close agreement with the quantities of chlorine already given as contained in the rain for the same period (Table XV., p. 264). In forty-three months the amount of chlorine supplied by the rain amounted to 47·60 lbs. per acre, or really to somewhat more, as the method of analysis employed gave rather low results. The quantities of chlorine removed in the drainage-waters during the same time were respectively 52·90 lbs., 57·34 lbs., and 51·50 lbs. for the three gauges. There can, therefore, be little doubt that the soil has been completely washed out, and is now dependent on the rain for all the chlorides it contains.

The quantity of nitrogen as nitrates, and of chlorine removed by the drainage-water from an acre of soil during each of the three drainage years included in the period of the experiment, will be found in Table XXXV.; the results are arranged in the order of the amount of drainage.

TABLE XXXV.—AMOUNTS of NITROGEN as NITRATES, and CHLORINE as CHLORIDES, contained in the DRAINAGE-WATER from the three DRAIN-GAUGES in THREE DRAINAGE YEARS (Oct. to Sept.)

20-Inch Drain-Gauge.				40-Inch Drain-Gauge.				60-Inch Drain-Gauge.			
Year.	Drainage Inches.	Nitrogen lbs. per Acre.	Chlorine lbs. per Acre.	Year.	Drainage Inches.	Nitrogen lbs. per Acre.	Chlorine lbs. per Acre.	Year.	Drainage Inches.	Nitrogen lbs. per Acre.	Chlorine lbs. per Acre.
1879–80	9·743	39·78	8·13	1879–80	10·326	27·44	8·94	1879–80	9·354	28·11	7·49
1877–8	14·591	43·87	15·31	1877–8	16·605	38·95	17·74	1877–8	15·734	45·45	15·65
1878–9	26·772	62·27	20·30	1878–9	26·907	48·29	21·55	1878–9	25·186	63·29	19·96
Mean	17·035	48·64	14·58	Mean	17·946	38·23	16·08	Mean	16·774	45·62	14·36

These three years fortunately include some very different seasons. In 1879–80 we have a year in which the drainage is rather below the normal quantity, and in 1878–9 we have a year in which the drainage is considerably more than twice the normal quantity. We see that an increase in the amount of

drainage is accompanied by an increase in the amount of nitrates removed from the soil, but the latter does not increase at the same rate as the former. The increase in the amount of chlorides removed from the soil is, on the other hand, at nearly the same rate as the increase in the drainage. Expressing in figures the average results of the three gauges, the increase of drainage in these two extreme seasons is from 100 to 268, the increase of chlorides from 100 to 252, and the increase of nitrates from 100 to 182. As the rain which produces the increased drainage also supplies the chlorides, it is easy to understand why both drainage and chlorides should increase at a similar rate. The rain, on the other hand, supplies but an insignificant amount of nitrates, and only up to a certain point increases the rate of nitrification in the soil; the larger amount of nitrates removed by heavy rain is thus in great measure simply due to the more thorough washing of the soil.

As the quantity of the nitrates removed from the soil depends so greatly on the amount of drainage, and as this has been very variable during the last four years, it is impossible to say whether, on the whole, the amount of nitrates yielded by the drain-gauges is, or is not, diminishing. It is, of course, however, probable that the production of nitrates is slowly becoming less, and that in the earlier years of the experiment the amount contained in the drainage-waters was even larger than at present.

The large quantity of nitrogen as nitrates removed per acre by the drainage-water is a fact of great interest. The figures at the foot of Table XXXIV. (pp. 344–5) show that the annual amount of nitrogen as nitrates removed in the drainage-water was, on an average of four years, 45·51 lbs., 36·32 lbs., and 43·59 lbs. respectively from the three drain-gauges, the mean of all being 41·81 lbs., equivalent to 268 lbs. of ordinary nitrate of sodium. If we suppose that the drainage-water contained at the same time 0·5 part of nitrogen per million in the form of organic matter and ammonia, we shall have a total of 43·77 lbs. as the quantity of nitrogen removed in one year from an acre of uncropped soil for 17·281 inches of drainage. Such a quantity of nitrogen is equal to that contained in an average crop of wheat or barley; its loss to the soil in the drainage-water is thus a matter of grave importance. Are we to suppose that a similar soil kept as bare fallow for an entire year in ordinary agricultural practice would have suffered a similar loss? The question really resolves itself into two: 1. Would the production of nitrates be similar in the two soils? 2. Would the loss by drainage be equal?

The experimental soils being supported on perforated iron

plates would, during dry weather, be aërated from below; the subsoils would thus be more freely exposed to air than could happen in an ordinary field soil. On the other hand, the thorough tillage which accompanies an agricultural bare fallow must expose the surface-soil of the field to the action of the atmosphere more fully than can take place in the drain-gauge. The supply of oxidisable organic matter must also now, after ten years of exposure to the atmosphere and washing by rain, be considerably less in the soils of our drain-gauges than in a soil which has recently been manured and cropped.

Towards the end of September 1878 the soil and subsoil of three plots in two of the experimental fields at Rothamsted, which had been left as bare fallow all the summer, were sampled, and the quantity of nitrates they contained determined. To the depth of 20 inches they contained respectively 34 lbs., 41 lbs., and 55 lbs. of nitrogen in the form of nitrates. The first two soils had received no nitrogenous manure for a great many years, and were probably in a state of greater exhaustion than the soils of the drain-gauges; the third had received nitrogenous manure, but had grown two crops since its application. In all cases the crop preceding the fallow had been barley or wheat, and as these crops are known to remove nitrates very thoroughly from the soil, we may fairly conclude that the nitrates found were mainly the result of nitrification during the last twelve months. The amount of nitrate actually found would not, however, represent the whole produced, some must have been already lost by drainage. Indeed, during the six summer months of 1878, about 17 lbs. of nitrogen in the form of nitrates had been removed in the drainage-water of the 20-inch drain-gauge.

With this evidence before us, we are disposed to conclude that nitrates equal to 50 lbs. or more of nitrogen per acre may be produced in a single year's bare fallow of the arable soil at Rothamsted.

With regard to the loss which a soil under bare fallow would suffer by drainage, we must recollect, in the first place, that the rainfall during the four years' experiments with the drain-gauges just quoted was far above the average, amounting in fact to nearly 33 inches per annum; the drainage has consequently averaged 17·281 inches per annum, while with the normal Rothamsted rainfall the drainage would only be 10·92 inches, and with a rainfall of 25 inches but 7·62 inches. With a smaller drainage the loss of nitrates from the soil would considerably diminish, though not in the same proportion as the diminution in the drainage, as with a less rainfall the drainage-water would become stronger. We have one whole year of moderate

drainage within the period of our determinations; in this year, 1879–80, the mean drainage was 9·808 inches, and the mean quantity of nitrogen as nitrates removed in the drainage-waters 31·78 lbs. per acre.

In a field of good natural drainage, with a soil of the same physical characters as our drain-gauge soils, we should expect the amount of drainage to be the same when both were under bare fallow. It, however, by no means follows that, with an equal production of nitrates and an equal drainage, the soil exposed to a one year's fallow would lose as large a quantity of nitrates as the soils of the drain-gauges. The average amount of nitrates lost by the drain-gauge in a year may perhaps fairly represent its annual production; but in order to *part* with this amount it must itself contain much more, as the soil is never at any time thoroughly exhausted by drainage.* Unless, therefore, the production of nitrates is far more active in the field than in the drain-gauge, the amount lost during the first year of fallow would be much less than that experienced at the drain-gauge. Again, nitrates being produced chiefly in summer time, an ordinary bare fallow suffers only from autumn and winter drainage, and not from that of the whole year.

Though for the reasons just given the loss of nitrates by drainage may be considerably less in an ordinary agricultural fallow than in our own drain-gauge experiments, the loss must clearly be a very serious one whenever the season is wet. Bare fallow can only be thoroughly successful in a dry climate. Under such circumstances the active production of nitrates which takes place in a fallow will doubtless greatly increase the fertility of the soil for the succeeding crop. In a wet climate the practice of bare fallow must result in a rapid diminution of soil-nitrogen. The influence of cropping on the loss of nitrates by drainage will come under notice in Part III. of this paper. We have already, however, had illustrations of one mode in which a crop will greatly diminish such loss, namely, by largely increasing the amount of evaporation, and thus diminishing the amount of drainage.

(*To be continued.*)

* Of the large amount of nitrates contained in the drain-gauge soils we get some idea from the fact that the 20-inch gauge parted with over 62 lbs. of nitrogen per acre in 1878–9, and still was far from being exhausted.

XXIII.—*Polled Aberdeen and Angus Cattle.* By James Macdonald, Editor 'Irish Farmers' Gazette,' Dublin.

I.—Origin and Early History.

It would serve no good end to revive the discussion as to the origin of our domesticated cattle. For all practical purposes it matters little whether the multitude of widely different varieties of cattle to be found throughout Europe at the present day can really claim one common origin in the ancient *Bos longifrons*, or whether they trace back both to the *Bos longifrons* and the *Bos urus*. To some minds the idea seems incomprehensible that the shaggy, muscular, fierce-looking West Highlander and the thin, lanky, fawn-like Jersey had originally sprung from the same stock. Natural history, however, supplies many reliable instances of sister currents diverging far more widely than these have diverged. Great as are the varieties of form, colour, and characteristic presented by the domesticated cattle of Europe, there is little doubt that they have been brought about entirely by differences in climate, food, shelter, systems and accidents (or "spontaneous variation") in breeding, and by other local and exceptional influences.

Authorities agree in stating that those ancient cattle from which the existing stock have been descended were all provided with horns. The breeds of Polled Cattle which we now possess must therefore be regarded as forming a distinct departure from the ancient order of things. As to when and how that departure may have been effected one can merely conjecture. Quite probably a polled strain sprang up by accident, or by what Darwin says we in our ignorance may call "spontaneous variation." It is sometimes asserted that all the different British polled breeds are descended from one offshoot from the parent-stem; but whether that is actually the case or whether they are the result of not one, but several instances of accidental breeding or "spontaneous variation," we have no reliable means of knowing. This much, however, we do know, that from time immemorial there have been throughout the British Isles several varieties of polled cattle, all having many points in common, but each presenting certain distinct characteristics peculiarly its own. These polled varieties are now grouped in three well-known breeds,—the Norfolk and Suffolk, the Galloway, and the Aberdeen or Angus. The last of these three forms the subject of this paper.

The improved Polled Aberdeen or Angus cattle are the lineal descendants of the ancient polled cattle of the north-east of

Scotland—the "Doddies" of Angus and the "Humlies" of Buchan. During recent years much discussion has taken place as to the origin and improvement of the breed, the main point at dispute apparently being whether Aberdeenshire or the ancient county of Angus, now embraced in Forfarshire, ought to be regarded as the original home or cradle of the breed. Viewing the subject from the standpoint of an outsider, as an ardent admirer of the breed, but not in the slightest degree personally interested on either side, I have always regarded this discussion as not only unwise, but also utterly worthless. In that belief I have hitherto studiously avoided taking part in it; and on the present occasion I pass it over with this brief reference. In the opening sentence of this paragraph I have stated the real origin of the improved Polled breed; neither Aberdeenshire nor Forfarshire has any special claim to the credit of being the original home or cradle of the breed. It belongs just as much to the one as to the other, and is not enjoyed even by them alone. It is also shared by the counties of Kincardine, Banff and Moray, for, as I have said, the improved polled cattle are the lineal descendants of the ancient polled cattle, not of any particular county, but of the north-east of Scotland.

Going back as far as history and tradition can be trusted to guide us, we find that in that part of the north-east of Scotland comprising the counties of Forfar, Kincardine, Aberdeen, and Banff, there existed two distinct races of cattle. The higher ground was occupied by a horned race; and the lower districts partly by the same horned race, partly by a polled breed, and partly by crosses between the two. It is to be regretted that the earlier writers on rural subjects were not more precise in their descriptions of the various breeds of cattle. In several of these early works we find the breeds of cattle in many parts of the country simply described as being large or small, or as useful and docile; or wild but handsome. There is, unfortunately, some ambiguity of this kind in regard to the early history of the Polled Aberdeen and Angus breed, and that is perhaps to some extent to blame for the discussion just referred to. Of the existence of polled cattle in Forfarshire, or in the ancient county of Angus, we have written proof from the eighteenth century. The Rev. James Playfair, in his report on the parish of Bendochy, near Coupar-Angus, which is dated 1797, and which appears in the 'Old Statistical Account of Scotland,' states that many of the cattle in the parish at that time were "dodded, wanting horns." In a volume entitled 'A General View of the Agriculture of Angus,' dated 1813, it is stated that "a great proportion of the permanent stock are himlies—that is, they have no horns." Coming next to Youatt's well-known work on 'Cattle, their

Breeds and Management,' written about 1835, we find this statement:—"There have always been some polled cattle in Angus; the country people call them himlies or dodded cattle. Their origin is so remote, that no account of their introduction into this country can be obtained from the oldest farmers or breeders. The attention of some enterprising agriculturists appears to have been first directed to them about sixty years ago"—about 1770 or 1780. This celebrated authority gives a full description of the Angus doddies as he found them, and details at length the doings of the first great improver of the breed, the late Hugh Watson of Keillor.

All the early writers on the agriculture of Aberdeenshire speak of the Buchan cattle—those occupying the lower part of the county known as Buchan—as a distinct breed; but in no work dated before the present century have we found it stated whether they were polled or horned. Some of these early writers give a minute description of the Buchan breed, and yet make no mention of horns. It is stated by Keith, in his 'Diocese of Aberdeen,' dated 1730, that the Thanedom of Buchan, which originally extended from the River Don to the River Deveron, was so named because it abounded in old pasture and paid its rent in cattle,—"for the word in Irish means cow-tribute." But while none of these earlier writers actually state that the famous Buchan breed of which they make mention were polled, it would be impossible for any one who inquired anything like fully and impartially into the subject to avoid coming to the conclusion that the Buchan humlies of Youatt's time and the Buchan cattle of Keith's day belonged to the same race; in fact, that the former were the direct descendants of the latter, and that the latter like the former were "humle," or hornless. Youatt states that he found a distinct breed of polled cattle in the lower parts of Aberdeenshire, and he also says that while some considered them the produce of Galloways, introduced about the commencement of the present century, others said that they had existed in Buchan from time immemorial. The former theory of the origin of the Buchan humlies must be dismissed as erroneous, for if such a number of Galloways had been introduced into Aberdeenshire about the time Youatt refers to, or even long before it, as would have produced the vast numbers of polled cattle that are proved beyond doubt to have existed in Buchan as far back as 1830, there would undoubtedly have been some printed record of the importation. We find frequent references in various early works to importations of Ayrshire and other southern breeds even before the present century had dawned; but nowhere do we find record of any large importation of Galloways. By the commencement of

the present century the cattle trade of Aberdeenshire had assumed considerable proportions; and one of the leading cattle markets in the county was the great Aikey Fair held in Buchan, where local and southern dealers attended in large numbers and bought cattle for England and for some parts of the south of Scotland. In several works we find it stated, on the authority of well-known Aberdeenshire cattle-dealers who had attended Aikey Fair early in the century, that a large proportion of the stock exposed at that market were Buchan humlies, or crosses between them and various horned breeds. They all speak of the popularity of the native Buchan breed, describing it as smaller but of better quality than the crosses and other cattle shown. In his recently issued 'History of the Highland and Agricultural Society,' Mr. Ramsay gives an extract from a communication he had received from Mr. George Stodart, "lately farmer in Culter-Cullen, Foveran, now (January 1879) in his 97th year, and who made his first purchase of cattle in 1801." Mr. Stodart says "there were at the beginning of the century both polled and horned cattle in Buchan, but the horned cattle were mostly in the Highlands of Aberdeenshire. The horned and polled were mixed in the low districts. The biggest market was Aikey Fair, and there was another market, Kepple Market, in New Machar. At Aikey Fair about one half of the cattle were polled and one half were horned, but they were all of the Aberdeenshire breed." The writer of some interesting notes on the early history of the polled breeds, which appeared last spring in the 'Banffshire Journal,' gives a great deal of evidence in reference to the existence of polled cattle in Aberdeenshire about the end of the last century and beginning of the present. He says: "The late Mr. John Marr, Cairnbrogie, Tarves, commenced to breed Buchan polled stock in 1810, and exhibited animals of this breed at the Highland Society's Shows at Aberdeen in 1834 and Dundee in 1843. The late Mr. George Stodart, Culter-Cullen, Udney (born September 1783; died June 1830) [father of Mr. George Stodart already quoted], bred Polled Aberdeenshire cattle, commencing in 1812. The forefathers of Mr. Barclay, now in Strocherie, bred Aberdeenshire cattle at Auchmull, King-Edward, for more than two hundred years, most of their animals being polled." The late Mr. William Strachan, Ardmeallie, who was an extensive breeder of cattle early in the century, states that in 1835 he purchased a Shorthorn bull to cross with his stock of cows, which "consisted generally of Buchan Hummel, the Aberdeen Horned, or a mixture of these breeds." Mr. William Anderson, Wellhouse, Alford, in a communication to me (dated 13th April, 1881), says: "My father and uncle farmed land in the Vale of Alford in the end

of the eighteenth century, and bred polled cattle. Sometimes the bulls were black and sometimes brindled, but they were always polled. My father would not have bred from a horned bull, and he always disliked horned cattle. He and my uncle took prizes for Black Polled cattle at the Shows of the Vale of Alford Agricultural Society, formed soon after 1830."

Much more evidence of a similar kind could be given, but in this short paper anything like a complete history of the breed is out of the question. Enough has been presented to indicate the nature of the evidence available in support of the statements that in Angus and Buchan, and other low-lying parts of the north-east of Scotland, there was a native polled breed of cattle (*native* in the sense that they were found to exist in these parts at the earliest date to which history and tradition carry us back), and that the Improved Polled Aberdeen and Angus Cattle are the lineal descendants of that native polled breed. The two strongholds of the native polls were Angus in Forfarshire, and Buchan in Aberdeenshire. The Angus people called them "Doddies," the Buchan people "Humlies;" and thus their celebrated offspring have come to be regarded by many as having a double origin, as being a combination of two distinct breeds; while the fact is, that they are the descendants of one well-defined race—the ancient polled cattle of the north-east of Scotland—a breed popularly known at the commencement of the present century as Angus Doddies and Buchan Humlies.

It may be interesting here to refer to one of the several erroneous notions that are loosely indulged in with regard to the origin of the improved polled breed, especially in so far as their Aberdeen connection is concerned, namely, that the Aberdeenshire polled cattle are descended from a race of horned cattle once famous in that county. Even more than a hundred years ago the black horned cattle of Aberdeenshire were quite celebrated all over both England and Scotland, their size and fattening properties having been their distinguishing properties. To some extent these famed cattle were derived from the intermixing of the local polled and horned breeds; but it is well authenticated that in a large measure their superiority over contemporaneous breeds was due to an infusion of southern blood into the Aberdeenshire strains. In the north-east of Scotland, the lion's share of the farm work now accomplished by horses was done by oxen down to a comparatively recent date—in many parts far into the present century. The native breeds having then been too small, the landed proprietors and larger farmers of Aberdeenshire (as well as of the north-east generally) obtained their work-oxen from the south of Scotland, for many years from the Lothians, and afterwards from Fifeshire. When—more than

a hundred years ago—the Lothian and Berwickshire farmers gave up cattle-rearing and took to the raising of corn, good southern work-oxen became so scarce and high-priced, that the more enterprising agriculturists in Aberdeenshire were induced to rear their own oxen. They introduced bulls and cows of various breeds from various parts of the south; even some English and some Dutch animals having been imported. We are told, however, by Dr. Keith, in his admirable 'Agricultural Survey of Aberdeenshire,' published in 1811, that these earlier importations had but "a partial effect," and that satisfactory success was achieved only when the famous Fifeshire or Falkland breed had been resorted to. Dr. Keith says that "the Falkland breed, which was at this time one of the best in Scotland, had originally been raised from some English cows which that sagacious prince, Henry VII., had, 300 years ago, sent in a present to his eldest daughter, the Queen of Scotland, who had been married to King James IV." Falkland Palace in Fifeshire, having then been a royal residence, the breed which sprang from Princess Margaret's "dowry" was known as the Falkland or Fife breed. Of this breed, which was described as large and handsome, and mostly black and horned, a great many bulls were introduced into Aberdeenshire and crossed with the native polled and horned cows. This union was remarkably successful, the large handsome Fife bulls and the thick low-set native cows having produced a class of cattle combining the size and handsome shapes of the former with the excellent beef-producing properties of the latter. The great value of these crosses for the production of beef soon became known. They found their way into the beef-markets of England and the south of Scotland, ultimately becoming celebrated throughout the country. They were designated the black horned cattle of Aberdeenshire; and perhaps the fact that for a time their fame outshone that of all the other races in the county is mainly accountable for the erroneous impression entertained by some that they (the black horned cattle) were the real and only native breed of cattle in Aberdeenshire. Even at the present day some seem to regard these black horned crosses as the ancestors of the Buchan Humlies. The reverse, however, is more nearly true. Instead of the black horned cattle having been the progenitors of Buchan Humlies, the Buchan Humlies in reality were, in conjunction with other breeds, the progenitors of the famous black horned breed.

From the earliest descriptions existing, it would seem that there were hardly any distinguishing features between the Angus Doddies and Buchan Humlies. They were small in size, short in the legs, short but thick in body, fine in the bone, and as a

rule black in colour, some having been brindled, some dark red, some black with brown tinge and white spots, and others what Youatt calls "silver-coloured yellow." They were reported to have been excellent beef-cattle, producing meat of the very finest quality, and yielding a large quantity of beef in comparison with their live weight. They also got the credit of having been good dairy-cattle, the Buchan cows in particular being noted both for the quantity and quality of their milk. The late Mr. Macpherson, factor for the Duke of Richmond at Huntly, states that early in the century Buchan cows were used in Banffshire for "the purposes of the dairy." Youatt states that Buchan cows sometimes gave as much as seven gallons of milk per day, three to four gallons having been general; and that too with poor feeding compared to what dairy-cows now get—principally oat-straw in winter, with sometimes a little plotted hay,—hay on which boiling water had been poured.

II.—Improvement of the Breed.

There is good reason for believing that some time before the advent of the present century the excellent beef-producing properties of the Angus Doddies and Buchan Humlies had been discovered, and to a slight extent developed by the exercise of more than ordinary care in breeding and feeding. While Aberdeenshire may fairly enough claim to have in later days contributed more largely to the advancement of the breed, the county of Forfar is equally well entitled to the credit of having been the first to commence its improvement in thorough earnest. By a good many enterprising Forfarshire agriculturists, notably the late Mr. Mustard, Leuchland, and the late Mr. Hugh Watson's father, herds of the pure polled breed had been formed, and some improvement effected by the advent of the century. The systematic improvement of the breed, however, must be dated from 1808. In that year Mr. Hugh Watson, tenant of the farm of Keillor, Meigle, Forfarshire, laid the foundation of what in his skilful hands became a widely celebrated herd of pure-bred polled cattle. Hugh Watson was a man of surpassing intellect, great perseverance, and accurate judgment; a man in many ways presenting a striking resemblance to his great prototypes in the Shorthorn world, the brothers Colling, who had commenced the systematic improvement of their favourite breed just twenty-eight years (in 1780) before the famous Keillor polled herd was founded. It has often been remarked with truth, that what the Collings were to the Shorthorns, Hugh Watson was to the Polled Aberdeen and Angus breed. He was the first great improver of the

breed, and no one grudges him the credit of that honourable distinction.

In the year 1808 Hugh Watson succeeded his father in the farm of Keillor, and among the stock left to him were six cows and a bull of the native polled breed. Not satisfied with these as a foundation for the herd he had decided to build up, he in the same year (1808) went to a fair at Trinity Muir, near Brechin (the fairs at Trinity Muir were at one time among the most important in the country), and there he purchased ten of the best polled heifers and the best polled bull he could find. It is stated that with these sixteen females and two bulls he founded the celebrated herd of Keillor Doddies. Of the great success which Hugh Watson achieved as a breeder of polled cattle, we have perhaps in the words of the late Mr. William McCombie of Tillyfour the best testimony. Mr. McCombie says: "We all look upon him (Hugh Watson) as the first great improver, and no one will question his title to that distinction. There is not a herd in the country which is not indebted to Keillor blood."

There is, unfortunately, comparatively little known of Hugh Watson's operations as a breeder. In his wide circle of intimate friends he included the late Mr. John Booth, Mr. Wetherell, and other noted breeders of Shorthorns; and there is good reason to believe that in many points connected with the building up of his herd of improved polled cattle he was to some extent guided by the experience of these great patrons of the rival breed. Mr. Dixon, in 'Field and Fern,' says Hugh Watson kept in his eye as models "'Bracelet' and 'Charity,' and one or two more of the pure Booths;" and that "he never scrupled to say that his best cattle showed much of the Shorthorn superiority in hair and touch." His motto would seem to have been, "put the best to the best, regardless of affinity or blood." He bred from none but the choicest specimens at his command, and did not hesitate to follow the example of the Collings, the Booths, Thomas Bates, and other celebrated Shorthorn breeders in mating animals closely related to each other. It is evident that he practised in-and-in breeding to a considerable extent. It is also clear that he aimed at building up particular lines or families, and that to some extent he bred each of these families within itself. He did not pursue persistently that intricate system of in-and-in breeding that was followed by most of the noted early improvers of Shorthorns; but, so far, he in this point followed their example. Perhaps the truest description that could be given of his method of breeding is that he bred from none but the best—those that came nearest to his ideal—and that he did not care whether these were closely

related or not. He no doubt discovered that under his improved system of breeding, which may truly be called a system of "selection," he could raise better animals than could be found on Trinity Muir, or anywhere else in those days, and that of course led him to breed in closer relationship than he might otherwise have done. He may not have approved of in-and-in breeding in principle, but, like the earlier improvers of Shorthorns, he frequently put it into practice, with results that were eminently satisfactory.

Early in his career Hugh Watson achieved great success in the Showyard with his improved polled cattle. During his first twenty years he won over a hundred prizes in national as well as local Shows. He made his first appearance as an exhibitor of polled animals at the Show of the Highland and Agricultural Society at Perth in 1829. His first-prize pair of polled oxen on that occasion attracted much attention by their size, symmetry, and quality. One of these was a great beauty, and a choice butchers' animal. He was exhibited at the Smithfield Show in London the same year, and there too he was greatly admired. When slaughtered by a leading metropolitan butcher (Mr. Sparks, of High Street, Marylebone), his carcass was found to be of very rare quality, the meat being fine in the grain and well mixed; while his fat weighed no less than 240 lbs.—about 84 lbs. more than the fat of the famous "Durham Ox." Another remarkable animal shown at Perth in 1829 by Hugh Watson was a heifer, which like the oxen were bred by himself, and which at the request of the Highland Society was exhibited at the London Smithfield Show as a sample of the excellence to which the Scotch Polled breed might be brought. There she was the admired of all admirers. She was then 4½ years old, and her dead weight was estimated at between 130 and 140 stones. Before being slaughtered, she, like the "Durham Ox," was publicly exhibited for some time. Her purchaser at Smithfield paid 50*l.* for her—a very handsome price for more than half a century ago. She was a round, low-set compact animal, the symmetry and evenness of her parts having been wonderful. The bone of her fore-leg, which her breeder long kept in his possession, is said to have been little thicker than that of a roe-deer. At the time she was killed, her brisket was barely 8 inches from the ground, and her inside fat was found to be equal in weight to one-fourth of her gross dead weight.

Another wonderful animal of Hugh Watson's breeding deserves notice. "Old Grannie," or the Prima Cow, No. 1 in the 'Polled Herd-book,' was one of the most remarkable animals of the cattle kind that ever lived, and formed a good example of the hardy character and longevity of the breed to which she

belonged. She was calved in 1824, out of one of Mr. Watson's cows, and died in July 1859, at the age of 35 years and 6 months. She was the dam of no fewer than twenty-five calves, eleven of which were registered in the first volume of the 'Herd-book.' She ceased to breed in her 29th year, and gave no milk after nursing her calf of the previous year. She was exhibited at the Highland and Agricultural Society's Show at Aberdeen in 1858, when she was 34 years old, and her owner was awarded a medal as being the exhibitor of so remarkable an animal. In the first volume of the 'Polled Herd-book' there is a plate of this wonderful cow, from a photograph taken two days before she died, at the request of the Prince Consort, who desired her photograph to be placed in his collection of cattle photographs at Balmoral.

After a distinguished career of over fifty years, Hugh Watson's herd was dispersed in 1860. Times were bad then, and the herd was not in good trim, having shortly before passed through a heavy ordeal of pleuro-pneumonia. The prices obtained were therefore comparatively low. The late Mr. William McCombie of Tillyfour purchased the highest-priced cow at 64*l.*, Mr. Thomas Ferguson, Kinnochtry, getting the next at 58*l.* 10*s.* The words we have quoted from Mr. McCombie indicate the great influence exerted by Keillor blood in improving the polled breed generally. The assertion Mr. McCombie made is a strong one, but we believe it to be well-founded. With the exception of the "Favourites" and the "Princesses"—two of his leading families—now well represented in the Kinnochtry herd, Hugh Watson's strains have so merged into other tribes as to be almost beyond recognition. Keillor blood, however, is still, as it ought to be, held in high estimation.

Among the other noted early improvers of the breed in Forfarshire and its borders, the following deserve special mention: — the late Mr. William Fullerton, Mains of Ardestie; the late Lord Panmure; the late Mr. R. Scott, Balwyllo; the late Sir James Carnegie; Lord Southesk; Mr. Bowie, Mains of Kelly, and his father; Mr. J. Lyell, Sheilhill; the late Mr. Ruxton, Farnell; Mr. Thomas Ferguson, Kinnochtry; Mr. Leslie, the Thorn; and Mr. W. Whyte, Spott. Lord Southesk, Mr. Bowie, Mr. Ferguson, Mr. Leslie, and Mr. Whyte are breeders still, and their efforts will be referred to afterwards.

Lord Panmure was an ardent admirer of the breed, and did not a little to accelerate its improvement: in 1838 or 1839 he commissioned Mr. Collier, Hatton, to select for him a dozen of the best polled heifers to be got in Aberdeenshire; and from these he bred a few animals that have become celebrated. Mr. William Fullerton commenced the breeding of polled cattle in 1834, and continued to take a warm interest in the

improvement of the breed till he died in 1880. His first purchase was "Black Meg" (766), from whom is descended the celebrated "Prides of Aberdeen" and allied tribes. The breeder of "Black Meg" is unknown, and there has been considerable discussion as to whether Buchan or Angus had the credit of producing her. Mr. Fullerton stated that he believed her to have been bred in Buchan. Her first famous descendant was "Queen-Mother" (348), who was out of "Queen of Ardovie" (a daughter of "Black Meg"), and got by the celebrated "Panmure" (51), who also claims "Black Meg" for his dam. "Queen-Mother" was purchased for 12*l.* 10*s.* at Mr. Fullerton's sale at Ardovie, when a yearling, by the late Mr. McCombie, of Tillyfour, for whom she not only won many Showyard honours, but also founded that grand family the "Prides," with which Mr. McCombie's name is so honourably associated. The Balwyllo herd was long one of the largest and best known in the country, and of its exceptionally high character we have strong proof in many existing herds. In the pedigree of the highest-priced animal of the breed, "Pride of Aberdeen 9th," the property of Mr. R. C. Auld, Bridgend, Alford, Mr. Scott's well-known bulls "President" (205), "President 2nd" (54), and "President 3rd" (246), all appear. The Sheilhill herd produced very fine animals, including the bulls "Prospero" and "Tom Pipes," which won leading honours both at the Highland Show in 1861, and at the Show of the Royal Agricultural Society of England at Battersea the following year.

Kinnaird Castle has long been a stronghold of the breed. A large and valuable herd was maintained by Lord Southesk till 1865, when it was annihilated by rinderpest. A fresh herd has been started within the last twelve months. To it I may refer afterwards. As to the origin and history of the first Kinnaird herd, I have been favoured with some interesting notes by the Hon. Charles Carnegie, brother to the Earl of Southesk, and a gentleman whose knowledge of matters pertaining to the breed is extensive and accurate. He says, "It is impossible to trace the origin of this stock (the old Kinnaird stock), which had probably gone on from generation to generation from a very remote period. At the time of the late Sir James Carnegie's minority, which lasted from 1805 to 1821, the home farm at Kinnaird was farmed by his mother, Lady Southesk, and then all the cattle were Polled Angus—indeed there was probably no other breed in the district. Lady Carnegie has frequently spoken to the writer about her cattle and their splendid milking qualities, as well as of her system of rearing calves. This system consisted in feeding the calf with

a mixture of skimmed milk and boiled turnips; her secret of getting the calves to take to it kindly being to put some of the boiled turnips in the very first milk that was given to the calf. If the calf had ever tasted pure milk, it would have been very difficult to have induced it to drink the mixture. As far as is known to the writer, no stock but Polled Angus was at Kinnaird till about 1834, when one or two Ayrshire cows and an Ayrshire bull were got. The best of the Angus cows were then sent to the neighbouring bulls, there being polled stock at that time at every one of the adjacent farms. The Ayrshire bull was discontinued in 1840, but some Ayrshire cows continued to be kept till 1849; and the writer remembers some excellent stock got by a polled bull from these remaining Ayrshires. They were generally black and polled, and some of them might have been taken for pure Angus. At the time of the writer's earliest personal recollection of the herd there were about seven pure Angus cows at Kinnaird, besides the cows belonging to the servants, all of which were polled. The prevailing colour of the Kinnaird herd, as of all the cattle in the country, was black, but there was hardly any herd which had not a brindled cow in it, and in many a dun or a grey. Those of the latter colour were called *droners*, and were supposed to have had a strain of Dutch blood in them, by descent from some cows brought over by a Dutch Company that attempted to reclaim the basin of Montrose. The oldest and most important tribe in the herd was the "Lady Anne" tribe. The cow, "Old Lady Anne" (743), was a very old cow at the time of the writer's earliest recollection, and she must have been calved about 1820, certainly not later than 1822. I believe, therefore, that "Old Lady Anne" (743) is the oldest cow recorded in vol. i. of the 'Polled Herd-book.' "Old Lady Anne" and all her descendants, even to the present, were, and are, excellent milkers. They had the especial property of continuing to give a large quantity of milk till close on the time that they were due to calve; and, if allowed, many of them would have continued to give milk without any break at all. The old cattleman at Kinnaird used to say that he believed from one end of the year to the other "Old Lady Anne" and her descendants gave more milk than any of the Ayrshires, although they might not give so much just after calving.

The destruction of that fine herd at Kinnaird was a serious loss to the interests of the breed. Fortunately, however, we have some of the best strains it possessed preserved and well represented in various herds. The "Old Lady Anne" family is represented by three strains—one through "Flora of Portlethen" (244), one through "Formosa" (186), and another

through "Lavender" (1007). The first two are from "Fanny of Kinnaird," and it is as her desendants that these strains are most generally known. They are an excellent lot of cattle; and, as stated by Mr. Carnegie, are noted milkers. "Lavender" was a granddaughter of "Old Lady Anne." Most of the other families in the Kinnaird herd are extinct except in the male line. The "Ericas" of Ballindalloch, one of the most valuable tribes of the breed, trace from the first herd at Kinnaird.

In Kincardineshire the breed has found several ardent admirers, who have by systematic and skilful breeding effected improvements in it. Chief among these were the late Mr. Robert Walker, Portlethen; the late Mr. Hector, Fernyflat; Sir Thomas Gladstone, Bart., of Fasque; and Mr. Scott, of East Tulloch. Few men did more real solid work in the improvement of the breed than the late Mr. Robert Walker. For over fifty years he was one of the leading breeders of polled cattle in the country; and, commencing in 1818, he built up and brought to a high state of perfection a choice herd of from 80 to 100 head. The main portion of his herd was dispersed after his death in 1874, but a part was retained and is being successfully carried on by his son, Mr. R. B. Walker, who succeeded him as tenant of the Mains of Portlethen. Mr. Walker reared some celebrated bulls, notably "Fox Maule" (305) and the "Banks of the Dee," both distinguished Showyard animals. Of Mr. Walker's great success in the Showyard, Mr. McCombie, in his 'Cattle and Cattle Breeders,' says, "It would be endless to attempt to sum up his victories—local, national, and international—they are spread over such a large surface." In one season the descendants of the "Banks of the Dee" gained no fewer than seven first prizes and one second.

Passing to the north side of the River Dee, we find a long list of successful early improvers. Headed by the late Mr. William McCombie, of Tillyfour, M.P., this formidable list includes, among others in Aberdeenshire, Mr. William McCombie, of Easter Skene; Colonel Fraser, of Castle Fraser; Mr. Harry Shaw, Bogfern; Mr. Reid, Greystone; the late Colonel Gordon, of Fyvie; the late Mr. Dingwall Fordyce, of Brucklay, M.P.; the late Dr. Robertson, of Indego; and, farther north, in the counties of Banff and Moray, Mr. W. J. Tayler, of Glenbarry; the late Mr. Morrison, of Bognie; the late Mr. Walker, Montbletton; the late Mr. Patterson, Mulben; Sir George Macpherson Grant, Bart., of Ballindalloch, M.P.; the late Mr. James Skinner, Drumin; the late Mr. George Brown, Westertown; and the late Mr. John Collie, Ardgye. The herds that belonged to several of these gentlemen do not now exist; but most of their leading strains are to be found in other herds, giving good

account of the judgment and skilful management of those that first brought them into public notice. Among the more notable of those extinct herds, those at Westertown, Mulben, Castle Fraser, Ardgye and Brucklay deserve special mention.

Probably few single individuals have ever done so much to improve and popularise any breed of live-stock as the late Mr. William McCombie, of Tillyfour, did to improve and popularise his favourite race of polled cattle. Taking up the good work so systematically commenced by Hugh Watson, William McCombie carried it on with a skill and success that have few equals, and that will hand down his name to posterity as the chief improver of the Polled breed. It has been said that what the Collings did for Shorthorns, Hugh Watson did for the Polled breed. It might be said with equal truth that what the Booths have been to the "red, white, and roan," William McCombie was to the "glossy blacks." Than that, higher credit could be paid to no breeder of live-stock; and every one who has any acquaintance with the subject will admit that it is due to the memory of the late Laird of Tillyfour.

In this paper anything like a detailed account of Mr. McCombie's work as a breeder of polled cattle cannot be attempted. Seeing, however, that for many years Tillyfour was regarded as the head-quarters of improved black polled cattle, and that Mr. McCombie did more than any other breeder to gain for the breed the world-wide reputation it now enjoys, a few of the leading features in the history of his herd must be presented. Born in 1805, Mr. McCombie died in the spring of 1880. He dated the foundation of his polled herd, which was dispersed in August 1880, from 1832, the first year in which he gained a first prize for a polled animal. His father, who owned the small estate of Tillyfour for many years, carried on an extensive trade in cattle between the north and south; and young Mr. McCombie, before he had completed his "teens," had also engaged to a considerable extent in cattle-dealing on his own behalf. He became tenant of Tillyfour about 1829, and soon after betook himself to the formation of a herd of the native polled cattle. He tells us that he was led by his father (who of course had had good opportunities of knowing the value of the breed as compared with others) to believe that "our polled cattle were peculiarly suited to our soil and climate, and that if their properties were rightly brought out, they would equal, if not surpass, any other breed as to weight, symmetry, and quality of flesh. I resolved that I would endeavour to improve our native breed." When he became tenant of Tillyfour he found on it a valuable stock of polled cattle, most of whose "dams and ancestors his father had

selected at the leading county fairs during the last decade of the eighteenth century, and the first two decades of the present century; and from these and the stocks of the "Stately Williamsons" of St. John's Wells and Mr. Walker of Wester Fintray, and others, he drew the material with which he founded his polled herd. Of these ancient strains there yet remain traces in several tribes of Tillyfour cattle. It was, however, with families raised from more recent purchases that he achieved his greatest success. Following the examples of Lord Panmure and Mr. Fullerton, Ardestie, he effected a combination of the Angus and Aberdeenshire varieties of the breed; and by skilful manipulation of the material he acquired he brought out results that probably exceeded even his own highest expectations. His greatest triumph was the building up of the "Queen" family, more particularly its "Pride of Aberdeen" branch. He would almost seem to have decided to "stand or fall" by it, his attention having been mainly devoted to its development. His success was complete. He purchased the mother of the "Prides" in 1844 for the sum of 12*l.* 10*s.*; at the dispersion of his herd in August 1880, ten "Prides" brought an average of over 80*l.* 10*s.* One "Pride," the fifth in descent from the 12*l.* 10*s.* heifer, reached the handsome sum of 270 guineas!

Her plucky purchaser was the late Mr. McCombie's nephew, Mr. R. C. Auld, who was latterly associated with his uncle in the management of the Tillyfour herd, and who has now, at his farm of Bridgend, Alford, a select young herd, full of the best Tillyfour blood.

The "Prides of Aberdeen" have the longest pedigree—that is, the greatest number of "registered" ancestors—of any family of the breed; and are on the whole, at the present moment, perhaps also the most valuable and most popular. Their only real rivals for that position are the "Ericas" of Ballindalloch, a tribe that many prefer even to the "Prides." The "Pride" family was founded at Tillyfour by "Queen-Mother" (348), bred by Mr. William Fullerton, Ardestie, and purchased at his sale in 1844, as a yearling heifer, by Mr. McCombie for the sum of 12*l.* 10*s.*, as already stated. She was out of "Queen of Ardovie" (29), whose dam was "Black Meg" (766), which, as formerly mentioned, was believed by her owner to have been bred in Buchan. Then for sire she had the celebrated "Panmure" (51), who, being also out of "Black Meg" (766), was uncle to "Queen-Mother." It would thus seem that though bred in Forfarshire, the foundress of the famous "Prides" was but very slightly removed from the pure Buchan "humlie." On this point there has been much discussion. Some claim "Black Meg" as an Angus cow, and therefore assert that the "Prides" are of pure

Angus descent. Others support Mr. Fullerton's belief that although "Black Meg's" breeder was unknown, she had really been bred in Aberdeenshire. In a letter written to the late Mr. McCombie, Mr. Fullerton expresses that as his belief. The point being more of local than general interest, I think it unnecessary to discuss its "pros" and "cons" here. "Black Meg" was evidently a good specimen of the ancient polled breed of the north-east of Scotland, and for all practical purposes it is of little or no consequence whether she was born in Buchan or in Angus, or somewhere else.

Mr. McCombie's success in building up the "Pride" family was in a very large measure due to his exemplary care in the selection of bulls. He had been induced by observation to set a high value on "Panmure's" influence, and strove hard to stamp his herd with the virtues of that celebrated animal. "Panmure" was purchased by Mr. Fullerton from his breeder Lord Panmure, in 1840; gained the first prize in a class of sixteen animals at the Highland Society's Show at Dundee in 1843; and was there sold to Mr. Farquharson Taylor, Wellhouse, Aberdeenshire, to whom he also gained several Showyard honours, besides producing many grand animals. Mr. McCombie looked upon him as the "Hubback" of the polls; and his portrait, painted by Philip, occupied the "place of honour" in the dining-room at Tillyfour. With some difficulty Mr. McCombie succeeded in obtaining possession of "Panmure's" son, "Monarch" (44), bred by Mr. Fullerton, and out of a cow named "Julia" (671), also bred at Ardestie. "Monarch" was a bull of handsome proportions, and had the credit of being the only animal that was ever placed before "Panmure" in a Showyard. "Monarch" was mated with his half-sister, "Queen-Mother," and the produce was "Lola Montes" (208), who was in her day invincible at the Shows at Aberdeen of the Royal Northern Agricultural Society, though her Showyard successes did not equal those of her famous mother, who in her thirteenth year won the second prize at the Highland Society's Show at Inverness in 1856. "Monarch" was followed by "Angus" (45), bred by Hugh Watson, out of one of his old Angus "Doddies," and got by "Grey-Breasted Jock" (2), the winner of first prizes at the Highland Shows at Dundee in 1843 and at Inverness in 1846. "Old Jock" (1), the sire of "Grey-Breasted Jock" (2), and grandsire of "Angus" (45), was "descended by dam and sire from Hugh Watson's old stock of Keillor "Doddies;" and was also a very handsome animal, having won the first prize at the Highland Society's Show in 1844, and having been sold for 100 guineas. It will thus be seen that "Angus" was a pure "Doddie," and could boast of an illustrious lineage. Put to

"Lola Montes," he produced the famous cow "Charlotte" (203), the winner of the first prize at the Highland Show in 1846; and the first prize and gold medal as the best of all the females at the *Concours Agricole Universel* at Paris in 1856. "Hanton" (228) was next brought to Tillyfour, Mr. McCombie having in 1854 purchased him from his breeder, Mr. Bowie, Mains of Kelly, for 105*l.* This bull gained the first prize at Paris in 1856, and the first at the Highland Society's Show at Berwick in 1854. On the female side, "Hanton" traces back to "Panmure," through three generations. On the male side, "Hanton" was closely related to "Angus." The former's sire was "Pat" (29); and "Pat" was more than half-brother to the sire of "Angus," for besides having been got by "Old Jock" (1), the grandsire of "Angus," "Pat" was out of a granddaughter of "Grey-Breasted Jock" (2), the sire of "Angus." It is thus seen that in breeding his "Pride" tribe Mr. McCombie practised "close" breeding to some extent. Along with these noted bulls Mr. McCombie used several bulls of his own breeding, notably three "Victors," all animals of excellent individual merit. But enough has been stated to indicate the high-class material employed by Mr. McCombie in establishing his leading tribe; and also to give some idea of the skilful manner in which that material was manipulated.

Mr. McCombie's success in the Showyard has few parallels in the history of farm-stock. In the third edition of his volume entitled 'Cattle and Cattle Breeders,' no fewer than seventeen pages are occupied by a mere record of the premiums won by animals belonging to the herd prior to 1875. Not content with a large share of Scotch and English honours, he several times entered international contests in France, and on all occasions returned with new laurels and fresh fame for his favourite blacks. Probably the crowning victory of his life was achieved at the great International Exhibition held at Paris in 1878. On that occasion, in addition to several leading "class" honours, he carried off with a group of beautiful young polled cattle, all bred at Tillyfour, not only the 100*l.* prize for the best group of cattle bred by the exhibitor in the division foreign to France, but also the 100*l.* prize "for the best group of beef-producing animals, bred by the exhibitor." * In fat stock as well as breeding shows, Mr. McCombie has often proved invincible; and altogether it may safely enough be said that the high reputation which the breed has deservedly gained beyond the bounds of the British Empire has, to a very large extent, been fostered by the remarkable Showyard achievements of the Tillyfour herd.

* See 'Journal of the Roy. Agric. Soc.,' Vol. XV. Part I., p. 187.

III.—Characteristics and Popularity of the Breed.

Formerly the breed, as we have seen, embraced a variety of colours. Black, with some white spots on the underline, prevailed. Some were brindled—dark-red and black stripes alternately; others were red; others brown; and a few what Youatt called "silver-coloured yellow." But since the systematic improvement of the breed was commenced in thorough earnest, all shades of colour excepting black have been at a discount, indeed almost entirely "dishonoured." Now the cry is, "black and all black." It is not easy, however, to wholly obliterate features that have at any time been characteristic of a breed; and even in the "best regulated families" a "reversion" to one or other of these unpopular shades of colour still occasionally displays itself. A shade of brown is not rejected, and not a few of the best-looking and most highly priced animals of recent years have had some white about the underline, chiefly around the udder. Red or brindled, however, are wholly inadmissible; and when animals of these shades do appear, they are not bred from. In most herds one or two red calves have appeared, but it is now very rare to hear of a brindled calf anywhere. But while these colours are unpopular, it should be remembered that they do not denote impurity; they simply indicate that an ancient characteristic of the breed, which modern fancy has doomed to extinction, has in the mysterious workings of nature been able to temporarily reassert itself.

And here it may be well to draw a distinction between those occasional unwelcome cases of "harking back" to discounted colours, and another deviation from the rule which now and again appears in some strains in the form of "scurs." These "scurs" are modified horns, differing from the latter in that they are attached loosely to the head and are much smaller in size. I do not regard them as a recurrence of an ancient characteristic of the breed, but rather as denoting contact at one time or another with some horned race. We know that both in Forfarshire and Aberdeenshire a race of horned cattle has from time immemorial—at least as far back as history and tradition carry us—existed alongside the ancestors of the improved Polled breed, the former occupying the higher, and the latter the lower ground. We have no record of any systematic combination of the two races; but a hundred years ago, and even less, farmers saw no special advantage in keeping any breed absolutely pure from generation to generation: they had not then learned—what not a few personally interested in the subject have even yet to learn—the value of an *unstained* pedigree. It may therefore be concluded that the two breeds were in these days occasionally

intermixed. And besides, we have it on record that, towards the end of the last century and early in the present, the Buchan "humlies" were crossed with Ayrshires, and the horned breed of Fife and other races; and the Angus "doddies" with Ayrshires and other breeds. Youatt tells us, no doubt on Hugh Watson's own authority, that the latter gentleman's famous Smithfield heifer, already referred to, "had a remote dash of Guernsey blood in her." In these circumstances, and in view of the known tendency of peculiarities in remote ancestors to display themselves from time to time, it is only natural that now and again an animal of the breed should appear with "scurs." They are scarcely ever seen on females. Some strains are more liable to them than others. In no family are they of frequent occurrence, and in some they have never once been observed. No effort should be spared to eradicate them from the breed. No animal showing the least sign of "scurs" should on any account be used for breeding purposes. If I had to choose between the two evils, I am not sure but I would rather breed from a red animal than from one with "scurs." The one feature is foreign to the breed; the other simply not in accordance with modern fancy.

From the earliest accounts of the breed it would seem that they were even then noted for symmetry of form, and that they were small in size. They were so small, in fact, that oxen of the breed were not considered suitable for the ordinary light farm-work of a hundred years ago. It would seem also that they have always been thick, low-set, round, very compact, fine in the bone, with soft hair, mellow skin, rich cover of flesh, fine head, hardy constitution, and great aptitude to fatten, their beef being of the finest quality, and beautifully mixed. The Polled Aberdeen and Angus cattle of to-day are just magnified animals of the same type. Most of the good points they formerly possessed have been still further developed, and brought to a higher condition of usefulness; while some defects that characterised the breed a hundred years ago have been wholly or partially removed. In the breed, as a whole, there has been a very great improvement in size during the present century. They are now large cattle; little inferior, indeed, in weight to any other breed in the country. At a casual glance they seem decidedly smaller than average Shorthorns; but on closer examination, or on the "scales," the difference is generally found to be much less than had at first sight been supposed, and often disappears altogether. As a rule, animals of the Polled breed are lower-set, or thicker and more compact than average Shorthorns; the latter being more "pointy," and longer in the legs. The ancient symmetry of the breed has been more than main-

tained, and now in this respect it is surpassed by no other breed in the British Isles, or perhaps anywhere else. A really good specimen of the breed leaves very little to be desired in the symmetry of its parts. The improved breed have wider and better sprung ribs than their ancestors had, and are also longer and better filled up from the hooks backwards; as well as more richly fleshed, finer in the bone, of superior quality, and sweeter and more gay, especially about the head. Their general fattening properties too, notably in regard to early maturity, have been very greatly improved. Some admirers of the breed, who have a distinct recollection of the animals that gained fame in Showyards twenty-five or thirty years ago, maintain that, in comparison with these, the Showyard animals of to-day exhibit little or no improvement. They admit that there has been great improvement in the "rank and file" of the breed, and that a much greater number of really good specimens are seen in the Showyards now than formerly; but some of those celebrated animals that a quarter of a century ago enlisted their warm admiration, have never in their eyes been excelled. The same statements have been heard in regard to almost every breed of live-stock in the country; but while in some instances they may be perfectly accurate, I believe that as a rule they are not so. We judge all things by comparison; and I believe that as we watch the progress of a breed that is being constantly improved, our standard of comparison becomes higher unconsciously. I really cannot help believing, especially if full value were given to character or appearance of "breeding," that better animals of the Polled Aberdeen and Angus breed have been shown within recent years than were to be seen a quarter of a century ago; and I am probably not far wrong in attributing the contrary impression which has been mentioned, to the fact that those who hold that impression have not made full allowance for the higher standard of comparison which their long experience must almost of necessity have brought them to apply.

In general form a model Polled animal differs considerably from a model Shorthorn. Both should be lengthy, deep, wide, even, proportionate, and cylindrical. The Polled animal, however, should be more truly cylindrical in the body than the Shorthorn. Its points should be more quickly rounded off, or, in other words, the frame of the Polled animal is not so fully drawn out to the square as that of the Shorthorn. Critics have pointed out in some of the best Polled animals now or recently living, a tendency to approach too nearly to the square type of the Shorthorn. In a beef-producing animal a broad, square frame can hardly be said to be a blemish, for if it is thoroughly well covered all over it will carry more beef than a rounder

frame. A compact well-rounded frame, however, has always been a leading characteristic of the Polled breed, and the main reason why a square Shorthorn-looking frame is objected to in a Polled animal is that such a form is foreign to the breed, and therefore apt to arouse suspicions of impurity. The admirers of the breed claim for it valuable natural properties not found to an equal extent in any other breed; and they fear that should the breed lose its characteristically natural appearance, it may also lose its superiority in those valuable properties — "the genuine article should always bear its trade mark." Careful improvers of the breed are specially particular as to the hind-quarters. While they aim at developing long, level, thick, deep quarters, they also strive to retain the rounded appearance which was originally one of the dominant characteristics of the breed.

The head of the Polled male should not be large, but should be handsome and neatly set on. The muzzle should be fine; the nostrils wide; the distance from the nostrils to the eyes of only moderate length; the eyes mild, large, and expressive; the poll high; the ears of fair size, lively and well covered with hair; the throat clean, with no development of skin and flesh beneath the jaws, which should not be heavy; the neck pretty long, clean, and rising from the head to the shoulder-top, and surmounted by a moderate "crest," which adds to the masculine appearance—a desirable point in a bull. The neck should pass neatly and evenly into the body, with full neck-vein. The shoulder-blades should lie well backwards, fitting neatly *into* the body, and not lying awkwardly *outside* it; they should show no undue prominence on the shoulder-top, on the points, or at the elbow. An upright shoulder in cattle is generally accompanied by a light waist—an important and, in all breeds, a much too common defect. The chest should be wide and deep, so as to give plenty of room for lung-development. The bosom should stand well forward between the fore-legs, and underneath should be well covered with flesh and fat. The crops should be full and level, with no falling off behind them; the ribs well sprung, springing out barrel-like, and neatly joined to the crops and loins; the back level and broad; the loins broad and strong; the hook-bones not too wide—narrower than in an average Shorthorn; the quarters long, even, and rounded, with no hollow from the hooks to the tail; the tail should come neatly out of the body, not too far up the back, and not higher at the root than the line of the back. A high tail-head was to some extent characteristic of the ancient Polled breed, but it is one of the defects that are being gradually removed by the more scien-

tific systems of breeding now pursued. Many good Polled cattle too have been found to show a development of soft worthless flesh and fat on the rounds behind; but that defect, which is disliked very much, is also almost obliterated. The tail should hang straight down close to the body all the way till it comes near to the level of the flank. On both sides of the tail the quarters should turn away in a rounded manner, swelling out downwards, and ultimately passing into thick deep thighs. The twist should be full, and the hind-legs set well apart, and not detached from the body until the level of the flank is reached. The flank should be full and soft, so that a good handful may be got out of it. The bottom line should be as even as the top and side lines; and the bones of the legs fine, flat, and clean, with plenty of muscle and flesh above the knees on the fore-legs. The body should stand neatly and gracefully on the legs; and when the animal stands, the fore-legs should be perfectly straight, and the hind-legs very slightly bent forwards below the hock. All over the frame there should be a rich and even coating of flesh. Even the hook-bones, and other prominent parts, should be well covered; and above all, there should be no patchiness—no hollows, and no rolls of hard flesh with spaces of soft, useless fat between them, such as are always found in a patchy animal. Except in rare cases the skin is fairly thick, but soft and pliable; it ought to be so free over the ribs that one could fill one's hand of it. The hair is, as a rule, not long, but fairly thick and soft; and in the best animals shows two growths, or rather two lengths, one short and thick, and the other longer and thinner. When walking, a good animal of the breed presents a very compact, graceful, and symmetrical appearance. Indeed, it is fairly enough claimed for the breed that in these, and in some other respects, it has hardly any equals, and no superiors. The above description refers more correctly to bulls than to cows. The latter, of course, differ considerably in character. The head is much finer, the neck thinner and cleaner, with no crest; the shoulder-top sharper; the bone altogether finer; the skin not quite so thick; the udder large, and milk-vessels large and well-defined.

In appearance as well as in other characteristics the Polled Aberdeen and Angus breed differs substantially from the Polled Galloway breed. The former has lived under a dry climate and has been fed in the house during a large part of the year. The latter has its home in a moist climate and has spent much more of its time in the open fields. The differences between the two are just such as might be expected from the different circumstances. The Galloway has a thicker skin and stronger

coat of hair, and has altogether a slightly more shaggy appearance than the northern Polled cattle. I desire, however, to avoid comparisons of this kind.

Admirers of the breed claim that it surpasses all others in the production of beef. On that point there is of course considerable difference of opinion; for at the present day, when the beef-producing properties of our other leading breeds, notably the Shorthorn and Hereford, have been developed to so high a degree, it could not be expected that with anything like unanimity any one breed would be accorded the premier position. Be that as it may, I think the Polled Aberdeen and Angus breed may fairly enough be said to be inferior to none as all-round beef-cattle, and superior to all others in some respects. The brilliant and unequalled position it has latterly taken alike in the Showyard and market-place sufficiently establishes its claim to that description. I have already referred to the distinguished achievements of the breed at the Paris Exhibition in 1878, where it carried off every single honour for which it was entitled to compete, including the 100*l.* prize for the best group of beef-producing cattle in the Exhibition. Then in our own Showyards, both fat-stock and breeding, it has won a leading position. The late Mr. McCombie, of Tillyfour; Sir William Gordon Gordon Cumming, Bart., of Altyre; Mr. James Bruce, Burnside; Mr. James Reid, Greystone; and others, have within the last ten or fifteen years won a large share of the leading honours at the English Fat-Stock Shows with animals of the breed. Among the great Showyard achievements of the breed were those of Mr. McCombie's famous Polled ox in 1867. That fine animal, bred at Tillyfour, was exhibited at the Birmingham and Smithfield Fat Stock Shows in 1867 when four years old, and at both Shows made almost a clean sweep of the special honours. At Birmingham he won the 15*l.* and silver medal as the best in his class; the Earl of Powis's silver cup, value 25*l.*, for the best steer or ox bred and fed by the exhibitor; two special prizes for the best Scot; the Hotel and Innkeepers' 30-guinea cup for the best animal in all the cattle classes; and the gold medal or 20*l.* for the best steer or ox in the Show. At Smithfield he won the first prize and silver medal as the best in his class, and the 40*l.* silver cup for the best steer or ox in the Show, along with the 20*l.* gold medal to his breeder. From Birmingham the ox was, by the Queen's desire, forwarded to Windsor for Her Majesty's inspection; and Her Majesty was afterwards graciously pleased to accept from Mr. McCombie her Christmas baron of beef from the carcass of this fine animal, of which Her Majesty had expressed great admiration. A year or two afterwards Her Majesty visited

Tillyfour, mainly for the purpose of inspecting Mr. McCombie's celebrated herd of Polled cattle, and she was interested in finding in Mr. McCombie's dining-room the head of the beautiful animal she had seen at Windsor. That ox was sold by Mr. Giblett to Messrs. Lidstone and Scarlett, Bond Street, London, for 120*l.*, the head having been retained by Mr. McCombie, who had it stuffed and placed in a prominent position in his dining-room at Tillyfour. In more recent years a great many meritorious animals of the breed have appeared and won the highest honours at the national fat-shows, but space cannot be spared for the enumeration of individual cases. It will suffice to state that, from a strictly butcher's point of view, the breed has now very seldom to yield to any other race of cattle.

The superiority over most other breeds, from a butcher's point of view, lies mainly in the excellent quality of their beef and in the high percentage of dead meat to live weight. As a rule, the beef of the breed is very well mixed and contains a greater proportion of compact finely grained flesh, and less soft coarse fat than most other kinds of beef. Inside, the carcass is usually well lined with fat of the finest quality, while in the density and quality of the carcass itself the breed may fairly enough claim the premier position among all our leading breeds of cattle. Some place the small Devon breed alongside it, if not even before it in this respect, but with that exception I do not think that any other breed in the British Isles will on an average yield so high a percentage of dead meat to live weight. In butchers' phraseology, they "die" well and "cut up" admirably. In all the leading fat-stock markets in the country the breed is held in high estimation, and, as a rule, commands the very highest prices—indeed, generally a higher price in comparison to their size and live weight than any of the other leading breeds. This is especially the case at the great Smithfield Christmas Market in London, where the plump compact Polls from the north never fail to find a ready sale at the highest quotations. The breed is admirably adapted for crossing with Shorthorns. Indeed, perhaps the very best beef-producing animal that has as yet been reared is a cross between a Shorthorn bull and a Polled cow. Throughout the north-east of Scotland that system of crossing is pursued very extensively. In fact, nearly nine-tenths of the famous Aberdeenshire beeves so highly prized in the London market are crosses between these two breeds. The best system is to mate the Polled cow and the Shorthorn bull; but the reverse system, which, owing to the scarcity of Polled cows, is extensively practised, also gives excellent results.

It is noticeable that as a rule those of these crosses that

approach the most nearly to the Shorthorn type are, if anything, the largest in appearance and attain the greatest live weight; but it is equally well known that those which most closely resemble the Polled breed not only bring the highest price when fat, and yield a larger percentage of dead meat to live weight, but also command the greatest number of customers and the readiest sale. An influential cattle-salesman in England stated to me the other day that for a black Polled ox or heifer, or even a cow, he could find three buyers for one who would bid for an animal of any of the other breeds; and that the longer he stood "week after week behind cattle in the markets" his estimate of black Polled cattle as beef-producers became greater and greater. At local fairs and sales of farm stock throughout the north-east of Scotland, lean black Polled one- and two-year old cattle generally bring from 1*l.* to 30*s.* per head more than a corresponding class of roan horned crosses.

Among many who are not directly acquainted with the improved Aberdeen and Angus cattle, an idea prevails that the breed is slow in coming to maturity—that it grows slowly and fattens slowly. Formerly that may have been the case; indeed, there is no doubt that it was. Now, however, the breed has been so greatly improved in that respect that it matures almost as early as any of the other leading breeds. When well fed from their birth good specimens of the breed become ripe at the age of from twenty-four to twenty-eight months; and it is also worthy of note that animals of the breed that are being fattened will retain the levelness and quality of their flesh longer than those of most other breeds. At the Smithfield Club Show in London in 1879, the highest increase in weight per day from birth was shown by a two-year-and-nine-months-old steer of the Polled Aberdeen and Angus breed, shown by Sir William Gordon Gordon Cumming, Bart., of Altyre, and bred by Mr. Grant, Advie. At the Smithfield Club Show in London in 1880, the average daily increase in weight of the six steers of the Polled Aberdeen and Angus breed under three years old was 1·78 lb., and that of the corresponding class of Shorthorn steers, 1·79.

Since the rage for "young beef" became so strong as it now is, a great many Polled cattle have been fed-off when from twenty-four to thirty months old, and at that age good animals bring from 25*l.* to 35*l.*, a few even exceeding the latter sum. In the London Christmas market, choice three-year-old black Polled bullocks bring from 40*l.* to 48*l.*, and even in some cases over 80*l.*

The breed cannot now be said to be distinguished for its milking properties. There is reliable evidence to the effect that formerly it was held in high estimation for its value for

dairy purposes. It would seem, however, that the main aim of the improvers of the breed has been the development of its beef-producing properties; and thus the milking powers of the breed have been somewhat neglected, perhaps even allowed to deteriorate to a slight degree. But they are not actually deficient in this respect, and with a little care their ancient reputation in the dairy might soon be restored. Several families of the breed are still excellent milkers, and I am glad to find these becoming more highly esteemed than they were a few years ago. As a rule, the breed is exceptionally hardy and healthy, and in fecundity and prepotency is excelled by none.

Polled cattle have risen rapidly in public estimation within the past ten or fifteen years. Their reputation may now be said to be world-wide. Animals of the breed have been exported to the Australian Colonies, to the continent of Europe, to Buenos Ayres, Canada, and the United States. In the two latter countries a keen demand has recently sprung up for them, and within the past six months over a hundred good specimens of the breed have crossed the Atlantic. There are now several Polled herds in England and Ireland; and within Scotland itself the breed is extending its territory. In all, there are over 100 Polled herds in Scotland, the large majority being in the counties of Aberdeen, Banff, and Forfar. Of the 'Polled Herd-book,' first published in 1862, six volumes have been issued. In the last volume there are the names of 190 breeders. It contains the register of 1193 animals—885 cows and heifers, and 308 bulls. There have now been registered 1930 bulls and 5054 cows and heifers—in all 6984. The 'Herd-book' is now owned by the Polled Cattle Society, which was organised in 1879 for the purpose of promoting the interests of the breed.

The rise in the value of the breed within the past fifteen years has been remarkable. Good average Polled cows, with mixed pedigree, bring, as a rule, from 30 to 45 guineas; while females of the better bred and more popular families bring from 50 to 100 guineas on an average—the "cream" of these fashionable tribes ranging from 120 to 270 guineas each. At a sale held by the Marquis of Huntly, at Aboyne Castle, in the autumn of 1879, six heifer-calves brought an average of over 42*l.* each. The prices obtained at the dispersion of the Tillyfour herd in the summer of 1880 have already been indicated. In May last (1881), the select herd belonging to Mr. H. D. Adamson, Balquharn, was dispersed at Aberdeen, when very high prices were obtained. The averages were: 15 cows, 74*l.* 18*s.*; 10 yearling heifers, 47*l.* 15*s.* 6*d.*; 9 calves, 20*l.* 15*s.* 4*d.*; and 2 bulls, 118*l.* 2*s.* 6*d.*—36 animals making an average of 56*l.* 11*s.* 4*d.* Eleven "Prides of Aberdeen"

brought an average of 96*l.* 8*s.* 1*d.*, and three "Sibyls" 116*l.* 4*s.* each.

IV.—The General System of Management.

It would have been interesting as well as useful to have presented a brief sketch of each of the leading herds. The limits of this paper, however, will not permit of that being given. It must suffice to simply enumerate the principal herds. The chief herds in England are those owned by Major Godman, of Great Smeaton, Yorkshire, Mr. Loder, M.P., Whittlebury, and Mr. W. B. Greenfield, of Beechwood Park, Dunstaple, all established in 1880 with very good blood. In Ireland there are two or three small herds; and I shall be surprised if the breed does not, before many years have passed, become as popular in the Emerald Isle as it is in its native land. Almost the only herd in the south of Scotland is that which Mr. T. L. Melville Cartwright, of Ladybank, Fifeshire, has carried on with much success for many years. In the Howe of Strathmore there are many large and valuable herds; and among the more important of these I may mention those belonging to Mr. T. Ferguson, Kinnochtry; Lord Strathmore, Glamis Cattle; Lord Airlie, Cortachy Castle; Lord Southesk, Kinnaird Castle; Mr. Whyte, Spott; Mr. Bowie, Mains of Kelly; Mr. Thomas Smith, Powrie; Mr. Ferguson, Balunie; and Mr. William Smith, Stone O'Morphie. Then in Kincardineshire excellent herds are maintained by Sir Thomas Gladstone, Bart., of Fasque; Col. McInroy, The Burn; Mr. Scott, of Easter Tulloch; Mr. Pearson, of Johnstone Lodge; Mr. F. G. F. Grant, of Ecclesgreig; and Mr. R. B. Walker, Portlethen Mains. The great bulk of the race is to be found in Aberdeenshire, where the herds are both numerous and of very high general merit. Those specially deserving of mention are owned by the Marquis of Huntly, Aboyne Castle; Mr. William McCombie, of Easter Skene; Mr. R. C. Auld, Bridgend; Mr. Anderson, Wellhouse; Mr. Reid, Baads; Mr. James Reid, Greystone; Lord Aberdeen, Haddo House; Mr. Hamilton, of Skene; Mr. Stephen, Conglass; Mr. Argo, Cairdseat; Mr. Craighead, Thomaston; Mr. Walker, Arduncart; Mr. Walker, Westside of Brux; Mr. James Farquharson, Easttown, Tarland; Mr. George Barclay, Yonderton; Mr. James Strachan, Wester Fowlis; Mr. C. McCombie, Tillychetly; Col. Ferguson, of Pitfour; Mr. Bean, Balquharn Mains; Mr. James Manson, Oakhill; Colonel Gordon, of Fyvie; Mr. James Fowlie, Brucehill; and Mr. R. F. O. Farquharson, of Haughton. In Banffshire there are several celebrated herds, chief among which are those owned by Sir George Macpherson Grant, Bart., of Ballindalloch, M.P.; Mr. Hannay, of Gavenwood; Mr.

Tayler, of Glenbarry; Mr. Skinner, Drumin; Mr. Grant, Auchorachan; Mr. Williamson, Netherwood; Mr. Smith, Inchcorsie; Mr. Robertson, Aberlour Mains; Mr. Petrie, Glencorrie; Representatives of the late Mr. Walker, Montbletton; and Mr. Stephenson, Blairshinnoch. In Morayshire, Sir William Gordon Gordon Cumming, Bart., of Altyre; Mr. McKessack, Earnside; and others, have excellent herds; while at Guisachan, Inverness-shire, Sir Dudley Coutts Marjoribanks, M.P., has recently established a most select and most valuable herd.

The general system of management pursued by the various breeders of Polled Aberdeen and Angus cattle differs but very slightly. It is as a rule simple and natural. High feeding has of course been freely resorted to in the training of showyard animals, but the great bulk of the breed has had hardly any "pampering" or unnatural treatment of any kind. To this last fact I have no doubt the well-known fecundity, general soundness, good health, and hardiness of the breed are mainly attributable. No race of animals can long withstand unnatural treatment, however systematic and skilful that treatment may be. As a rule, breeders aim at having the calves dropped between the 1st of December and the end of March. A good many come later, and some earlier, but these are not in favour. There is no doubt great advantage in having early calves, and breeders are now endeavouring to obtain as many as possible before the end of January. I may quote a few notes from some leading breeders as to their system of management. Mr. Thomas Ferguson, Kinnochtry, states that his calves suckle their dams till from six to eight months old; and that after being weaned they get straw, turnips, and cake or bruised oats, in covered courts. He feeds the bull-calves in the same manner all the winter after weaning, and generally sells them in spring when they are a little more than a year old, the prices generally ranging from 25 to 50 guineas. Last season his yearling bulls brought an average of over 40 guineas each. After Mr. Ferguson's heifers are ten months old, they get little food, excepting straw and turnips, until put upon the grass. Bulls are used when about twelve months old, and heifers bulled about two years old, seldom sooner. He feeds liberally the bulls that are in use, but he keeps his cows rather lean than fat. In winter his cows before calving are fed in covered courts, with about 30 or 40 lbs. of turnips per day along with barley- wheat- or oat-straw, generally either of the two former, as oat-straw is scarce. After calving, they get three times as many turnips as before; and in summer they are kept solely on the grass fields. Mr. Bowie, Mains of Kelly, rears most of his calves by the pail or "cog," giving at the outset about one pint, and gradually

increasing the quantity till it reaches seven or eight quarts. Small quantities of cake, corn, and turnips are ultimately given along with the milk. The better sorts, perhaps intended for showing purposes, are allowed to suckle their dams for longer or shorter periods, and when weaned are shut up in loose-boxes and treated to all sorts of good things. Mr. Bowie keeps his breeding cattle in moderately lean condition. He does not think it wise to bull heifers until they are two years old, as too early breeding checks their growth.. Mr. William Smith, Stone O'Morphie, states that he endeavours to have his calves dropped in February and March. He rears his calves upon their dams, till from six to eight months old, and then puts the young bulls into small covered courts, where they are fed on cut grass and vetches, and from two to three lbs. of linseed-cake per day, until turnips are ready to take the place of vetches and grass. The young bulls are sold for use when eleven or twelve months old. Heifers are treated in the same way as bulls, except that they get a smaller allowance of cake in winter and none at all in summer. He finds that heifers require no extra feeding on the fields to put them into good condition. Formerly his heifers were bulled in April, when just past two years old; but now he endeavours to have them bulled so that the calves may come in December and January, which, by those showing young animals, is found to be a great advantage. Cows get no extra food, simply turnips and straw.

Mr. R. C. Auld, Bridgend, states, that while early calving gives advantages in the way of strong yearlings, it incurs great expense in keeping cows and calves during the winter and spring, before the grass season comes round. He says that during the period of gestation cows should be kept on good pasture when outside, and fed on good food when inside; and that some days before calving it is well to take a small quantity of blood from them, as a preventive of milk fever; and to have them closed up by themselves in a calving-box. Just after calving, the cows should be kept quiet, well "bedded" with fodder, and get a drink of milk-warm water and oatmeal. The calf should be carefully watched until it "gets its legs;" and when the cow has been milked, a small quantity of the first milking should be given to the calf. He approves of cows being allowed to "lick" their calves, and regards the process as useful to the cow herself, as a medicinal corrective. He brings up the calves upon their dams; but if the cows are heavy milkers, he milks them dry now and again, until the calf is able to do so itself. The first fortnight is a most critical time with calves, and Mr. Auld states that when he sees any sign of dulness or inactivity in their system, he gives them a table-spoonful of treacle dissolved in

warm water. He finds that the calves are fond of this, and that it operates beneficially. He states that his late uncle, Mr. McCombie of Tillyfour, was always most careful to have his calves muzzled during the first fortnight, so as to prevent them attempting to eat straw. As soon as they are old enough to be able to take them, they should be taught to eat cake and turnips, and should be allowed plenty of exercise. Mr. Auld does not approve of cows being bulled sooner than six weeks after calving. Weaning usually takes place about the end of the grass season, and after that has been done, the "cording" of the calves (putting setons into their dewlaps) is carefully attended to. Young bulls and young heifers, he thinks, should be liberally fed, and cows kept in moderate condition. Mr. Anderson, Wellhouse, says: "Calves drop from the 1st of December to the 31st of March. Cows with bull-calves meant for sires rear their own calves, but I have several cows that rear two calves each. I deprive no calf of its mother's milk. For the first fortnight calves fed by hand get one imperial pint of warm milk four times a day; after that, milk is given three times a day, and the quantity is generally increased to four pints each time, till they are six or eight weeks old, when bruised oilcake or linseed made into gruel is given once or twice a day, along with the milk. A very small quantity of this gruel is given at first, so as to avoid scouring. Cut turnips and oat-straw are also given at that age. Calves are weaned when from six to nine months old. Young bulls get 2 lbs. of oilcake per day after they have been weaned, with turnips and straw, and they are allowed to go at large in a loose-box. They are sold at from twenty to forty guineas and upwards when twelve months old. Heifers are not so liberally fed as bulls; but after weaning they get 1 lb. of cake daily, along with grass, turnips, and straw. Early heifer-calves might be served in May or June of their second year, and if not then, certainly as early as possible the following year. Cows are on the fields all summer, with no extra food. In winter they get straw and turnips, with about 2 lbs. per day of oilcake for two or three weeks at calving-time."

Mr. Hannay, of Gavenwood, says: "I give nothing to cows beyond a supply of turnips and straw until within six weeks of their calving, when they get 3 lbs. of oilcake daily, and this allowance is usually continued for a month or so after calving. I endeavour to arrange so as to have the calves dropped between the end of December and the middle of April, as the early calves generally thrive best on the grass, and as calving is less dangerous before the cows get the full flow of the grass. I try as far as I can never to allow the animals to lose the calf-flesh,

and with this view I give a little oilcake before and after weaning. The calves here are all suckled; and after they are ten days old they are never tied up, but are allowed to run about the byre as they choose, clean straw being spread out behind the cows for them to lie upon. I have never had a calf injured by this freedom being accorded to them. Heifers here are never put to the bull till two years old. I disapprove of the practice of having them served when only yearlings, as this, as a rule, dwarfs their growth and weakens the constitution, probably both of themselves and their descendants. It is the practice here to put, at even a very early stage, the bull-calves and their mothers in fields separate from the heifer-calves and their mothers. I am also opposed to the use of yearling bulls beyond three or four times during the season, as tending to lessen their size and destroy their symmetry, with a risk also of unsatisfactory produce. The stock bulls here are kept each in a loose-box, opening on an open court, concreted, and boarded around to a height of 7 feet. In addition to their access all day to these open courts facing the sun, they are from time to time walked out for exercise. They are plentifully but plainly fed. We store the turnips in December, and as they are always at hand and in good condition, there is the less need for supplementing the natural foods. Care should always be taken to keep cattle free from draughts and to maintain their houses in a clean airy condition. I think a breeding-stock should be kept habitually from getting into what may be called poor condition, while over-feeding ought to be equally guarded against. Much caution is necessary, so as not to over-fatten two-year-old heifers for showing purposes. Indeed, it is questionable whether they should receive any extra feeding until they are safely settled in-calf. Prices vary according to quality and pedigree. I have sold a few very good animals at as low as 20*l.*, while on the other hand I have been offered 100 guineas for a yearling heifer, and 200 guineas for a yearling bull."

Mr. Tayler, of Glenbarry, pursues a similar system. Calves are weaned when from 6 to 10 months old, and then get a full allowance of turnips and straw with 1 lb. of best linseed-cake daily during their first winter. The young bulls are sold when from 10 to 14 months old, the average price for the past two years being 35*l.* In addition to turnips and straw, heifers get about 1 lb. each of linseed-cake every day during their first winter; and cows get 2 lbs. of cake daily for two weeks before calving, and a good feed of bran daily, with a little nitre three times a week, for three weeks after calving.

In Sir George Macpherson Grant's herd at Ballindalloch,

which is perhaps the most valuable herd of the breed in existence, an admirable system of management is pursued. The calving season is made up of December and three following months, but it often happens that cows fall behind. As a rule, the calves are allowed to suckle their dams for about six months. When housed, most of the cows are kept in loose-boxes, each cow having a box to herself and her calf. At weaning, calves are very carefully attended to. They are generally trained to eat linseed-cake before being weaned, and every possible effort is made to retain the calf-flesh, and not allow them to fall off after losing the milk of their dams. When the cold autumn evenings commence, care is taken to have all the cattle, at any rate all the young cattle, brought into a house over-night; and this also helps to maintain the condition of the stock. The young bulls require and always receive special attention. They are generally kept in an open court, where they have plenty of fresh air, but no draughts, and where they can have constant exercise. Their food consists of a liberal supply of good yellow turnips, as much oat-straw as they can eat, and about 2 lbs. of linseed-cake per day. It has been found advantageous not to allow them to lie or rest on heated dung, as that has a tendency to damage their legs. A ready demand is found for the young bulls at the highest current prices, the average for last year's crop having been about 43*l.* a head. Young heifers are treated much in the same way as young bulls, except that, unless grass or turnips are scarce, they get little or no cake. They are served when two years old. Cows, as a rule, get a small supply of turnips three times a day in winter and spring, the three meals making about 80 or 90 lbs. Latterly it has been found advantageous to give only about 40 or 50 lbs. of turnips, in two meals, supplemented by a mixture of about 1 lb. of bran, 1 lb. of crushed oats, and 1 lb. of linseed-meal, in a mash of cut straw or chaff. For about three weeks before and three weeks after calving cows get about 2 lbs. of linseed-cake per day. The over-feeding of breeding stock is studiously avoided, and the result is that the herd has been more than ordinarily prolific. Animals intended for showing purposes are of course treated more sumptuously than the other cattle in the herd.

To these general notes, indicating the system of management pursued by a number of leading breeders, little need be added. It will have been gathered that calves are, as a rule, dropped between the 1st of December and the end of April; and that the prevailing custom is to let the calves suckle their dams for six or eight months. A small quantity, from half a pound to a pound, of linseed-meal is usually given to calves each day for

some time before they are weaned ; and after weaning the allowance is increased. Young bulls are generally allowed 1 or 2 lbs. of linseed-cake daily, along with turnips and fodder or grass, until they are sold, at the age of from twelve to eighteen months. Heifers are similarly treated, except that they get less cake. In fact, in many cases they never taste cake after they have got beyond the stage of calves and until they commence to breed. Most breeders give their cows 2 or 3 lbs. of cake, or some equivalent, for a few weeks before and after calving; while stock bulls are always well fed during their active season. Some serve heifers when they are about eighteen months old, but the prevailing plan is to delay serving another six months. Too early breeding undoubtedly checks the growth of animals. I also think it would be advisable not to work yearling bulls quite so heavily as they are at present.

V.—Further Improvement of the Breed.

Great as has been the improvement in this breed of cattle during the past half-century, I think there is room for still further improvement. I should desire to see fully maintained its natural characteristics—in form, in hardiness, in the production of beef, and in other respects ; and I should also welcome well-directed efforts to ameliorate the milking properties of the breed, and to impart to its leading families a little more true high-bred character than they at present display. As has been stated, the breed is not reputed for its good milking powers. While, as a rule, it is rather better in this respect than it is generally understood to be outside the circles of its admirers, it is undoubtedly not so useful in the dairy as is desirable, or as it ought to be. We have seen that a century ago the breed was renowned for its milking properties, and I have no doubt that its old reputation might, by patient and systematic efforts, be revived in a comparatively short period of time. The improvers of the breed have aimed chiefly at the development of beef-producing properties, and have thus allowed the milking powers to become slightly impaired. I do not believe that beef will cease to be a profitable product on British farms ; but it must be admitted that dairy produce has come to have a higher comparative value than beef. It is therefore very desirable that breeders of Polled cattle should direct their attention to the developing of the lacteal properties of their herds. They should be careful to select bulls from cows and families that milk well.

Another point worthy of special attention by breeders of

Polled cattle is the building up of distinct, well-defined, line-bred families. I cannot here enter into a discussion of the interesting and disputed question of in-and-in breeding. In competent hands I believe in-and-in breeding to be a valuable and powerful agency for good; but if it is not thoroughly well conducted—and there are few capable of doing that—it may lead to disastrous results. I do not therefore desire to see it pursued by the general body of breeders of Polled cattle, or of any other race of farm-stock. I should rejoice, however, to see a few of the leading breeders, those best able intellectually and financially to undertake the work, following the example of the great improvers and pioneers of Shorthorns, and building up for themselves distinct line-bred families. I should like to see a few families of the breed built up in such a way as that they would not only be uniform in shape and character, but would also be possessed of one strong, unbroken, unadulterated family current. I believe in the doctrine that "like begets like;" but if we breed from composite animals—animals containing several conflicting family currents, perhaps the living influence of dead ancestors—we can have no confidence in the result. We do not know which *likeness* is to be produced—that of the immediate, or of more remote ancestors. Practical experience and scientific reasoning both teach us that no animal is so likely to reproduce an exact copy of itself as one that has been in-bred, or, in other words, one that contains one dominant, all-powerful family current. I therefore think that the existence of a few in-bred families of Polled cattle would help greatly to maintain, and even still further to improve, the high character of the breed generally. These families would be, as it were, strong springs of pure blood, from which fresh draughts might be drawn from time to time by the breeders of mixed herds. While these two points seem deserving of special attention, I also hope to see the general characteristics of the breed still further improved. If folly and fashion are not allowed to take the place of reason and utility, I think there can be little doubt that the breed has before it a brilliant and useful future.

XXIV.—*Secondary or Narrow Gauge Railways for Agricultural Purposes.* By W. H. Delano, Assoc. Inst. C.E.

The object of this paper is to draw attention to the laying of rails on ordinary roads, and to prove the feasibility thereof.

My experience has been principally in France, where, owing to the absence of turnpikes, the only practical difficulty in laying rails on roads lies in their inclines and curves. In France there exist 2237 kilometres of narrow gauge railways and 81 kilometres of narrow gauge lines laid on ordinary roads.

As will be seen, the problem has been completely solved, not only in France, but also in Belgium, Italy, Germany, Austria, and Hungary. We see tramways for passenger traffic in the main streets of large towns (and there is no reason for their not also carrying goods), railways in mines, elevated railways, whilst contractors and manufacturers use rails for the transport of earth and machinery; but the transport of purely agricultural products, and of materials used in agriculture, remains, in those agricultural districts of England where there are no main lines of railway, pretty much as it was fifty years ago.

Few steam traction engines are used on common roads, in spite of their evident usefulness and the efforts of their manufacturers.

Seeing that rail-transport is so advantageous on the crowded high roads of large towns, why should it not be so *relatively* upon the continuation of those roads in the country?

The great railway companies connect the large manufacturing towns and chief ports, competition producing in their case the lowest rates; yet agricultural centres have just as much need to be connected by the friction-reducing medium of rails, at an outlay proportionate to the traffic. It has been rumoured that the big railway companies are opposed to the laying down of light narrow gauge rural lines on the high roads; but if such roads were covered with light lines of rails, with sidings to the adjacent farms, what harm could be done to any vested interest? On the contrary, (1) production would be stimulated, and produce brought rapidly to the main lines of the large railway companies, swelling their traffic as streamlets swell rivers.

(2) Farmers and land stewards, after exporting their produce cheaply, could cheaply import artificial manures, oilcakes, lime, marl, clay, and sand, required to improve the land and increase its fertility.*

---

* By the kindness of Mr. James Howard, M.P. for the county of Beds, the

(3) Prices of produce in outlying districts would be equalised. In a country like England meat ought to be the same price everywhere.

(4) The magnificent old mail-coach roads would be utilised, and numerous localities and villages awakened from the torpid condition to which they were reduced by the construction of the large lines of railways and the consequent diversion of traffic.

To travel by existing railways from country districts, long distances must be traversed before the station is reached, and rates for short distances are high; whereas an agricultural railway running on the high road at low speed can take up passengers and goods at any point, and the conductor can be settled with on the spot.

The first idea of a railway for strictly agricultural purposes was Grant's system of rails fastened to wooden frames, which could be laid on soft or hard ground by agricultural labourers, in any direction, for the harvesting of root crops. It was exhibited at the Royal Agricultural Society's Show at Leeds, in 1861.

weight of materials carried in and out of the Clapham Park Farm Estate is here given :—

ESTIMATE of STOCK and MATERIALS, &c., brought to and taken from CLAPHAM PARK ESTATE during Twelve Months, in Tons.

BOUGHT.	Tons.	cwts.	qrs.	Tons.	cwts.	qrs.
Stock (Live Stock)	12	8	2			
Cake, Corn, and Feeding Stuffs..	250	0	0			
Hay and Straw	30	10	0			
Manures	38	0	0			
Wood	10	0	0			
Clinkers } For New Road	200	0	0			
Gravel } For New Road	250	0	0			
Night Soil and Ashes	150	0	0			
Coal	60	0	0			
Bricks and Drain Tiles	20	0	0			
				1020	18	2
SOLD.						
Corn*	45	0	0			
Wood*	30	0	0			
Stock (Live Stock)	33	0	0			
Poultry	1	0	0			
Milk and butter. Eggs	2	0	0			
Game	0	13	0			
				111	13	0
				1132	11	2

* Most of the corn, bad quality, is consumed upon the Farm. Estate 600 acres in round numbers.

It attracted little attention in England, but the French farmers caught the idea for their sugar-beet crops; and the same system, made much lighter and with wicker-work baskets for carriages, was used by M. Henri Corbin, near Paris. The idea was improved upon by M. Decauville, of Petit Bourg, and has been still further developed by Messrs. Fowler, of Leeds, who showed a system of steel rails and steel sleepers at Kilburn in 1879.

I saw a somewhat similar system at Messrs. Howards' Works at Bedford, in 1862, but there is no special system to be recommended. Having a line to lay in some asphalte works in Paris, I purchased the rails at the Creusot Works, and had the waggons made at my works; and any Farmers' Club or local Agricultural Association can act in the same way, taking the borough architect or local surveyor as engineer, and avoiding other professional expenses.

Suppose a line be laid from Bedford to Kimbolton on the high road, the local officials supplying the staff for a fair extra remuneration; the result would pay the subscribers directly, and evidently the indirect advantages to all would be very great.

At the present moment a miniature line of railway is running in Paris, from the Porte Maillot to the Jardin d'Acclimatation, in the Bois de Boulogne: the rails are laid upon longitudinal sleepers on the common road; the gauge is 1 ft. 9 in. The carriages are on the Irish jaunting-car plan, hold 20 people, and are drawn by one mule at a trot.

In 1867 Larmanjat's plan of an engine and train running upon one single central line of rail was tried in Paris; but, although since worked in France and Portugal, it does not seem to have had any practical success.

It is necessary to draw attention to the distinction between a simple railway and a tramway as laid in towns. The latter has often a *double* line of rails, and is therefore much more expensive.

In light railways laid on high roads, double rails are only necessary for crossings and sidings.

Light Railway in French Flanders.—There is a light railway running on the high roads from Lille to adjacent villages, Lille being the centre.

The capital of the Company is 204,000*l.* sterling. The gauge is that of the town tramway, 4 feet $8\frac{3}{4}$ inches, therefore not a narrow gauge.

The tariffs may be subdivided into a highroad-tax and the price of transport. For goods the rate is 3*d.* per ton; but this rate varies with the distance, 3*d.* being the minimum. It may be considered that the highroad-tax is represented by one-fourth the rate, and the price of transport the other three-fourths.

This Lille Company receives no subsidy from either the Government, the Department (county), or the town; but the town has granted a concession of twenty-five years' duration, for which the Company pays a fixed annual royalty of 12*l.* per waggon.

The rails, known as Hamilton's system, are laid upon sleepers 3 feet $3\frac{3}{8}$ inches apart. The iron rail weighs 28 lbs. to the running yard; the iron guard rail weighs 22·34 lbs. to the running yard. The steel rail weighs 26·40 lbs. to the running yard; the steel guard rail 20·30 lbs. to the running yard.

The authorization to lay the rails on the high- and bye-roads is granted by the Administration of Bridges and Roads (Ponts et Chaussées), after the plans have been duly submitted and accepted.

The privilege of using the public roads is compensated by the Company taking over the maintenance and repairs of 6 feet $8\frac{3}{8}$ inches breadth of roadway.

The terms of these concessions are given later on.

It must be noted that the Bridges and Roads Commissioners will not allow the *camber* of the public roads to be altered; as they are, so must the rails be, with all the gradients and sinuosities unchanged.

Sidings or branch lines can be laid into any farm or factory, in which cases the cost of laying, including that of plant, plus a bonus of 20 per cent. on the total, must be paid by the users.

Special rates are asked for cumbersome goods, like timber, or for materials of value, and the ordinary rates are tabulated as for a railway.

The trucks are stationed for loading and unloading, as required, and fetched by an up or down train.

The cost of laying the line on the stone-pitched roads was 1*l.* 4*s.* per yard run; on macadam, 1*l.* 1*s.* 2*d.* to 1*l.* 2*s.* 2*d.*

The trucks and waggons cost 60*l.* to 120*l.*; the passenger-cars, 160*l.*; and the engines, 600*l.* and 840*l.* each.

At Lille there have been no difficulties with the authorities. Free passes necessary for the public service have been issued, and others granted as a favour.

The maximum speed attained in the open country must not exceed 13·75 miles per hour, and 3·75 when passing through towns.

Horses soon become accustomed to the passing of the engines, the working parts of which are cased-in with sheet-iron.

The ordinary hand and steam brake is used.

It is possible that the farmers about Lille, who are not interested in the Lille narrow gauge railway, may object to the rails

on the high roads, which at certain times may elbow the ordinary traffic: but no complaints have ever been made.

The number of passengers transported by the Lille narrow gauge railway in 1880 was 450,000.

Between Lille and Roubaix there is a telephonic communication, which assures the service of the engines.

The maximum curve is 2187·20 yards, and the minimum 21·872 yards.

The engines are on Hughes's system; there are sidings and shunting stations and depôts to house the coals.

The question of warming the carriages during the winter months is being studied.

Light Narrow Gauge Railway in the Department of the Meuse.—The following information concerning this railway, which has its junction with the Eastern Railway of France at Sermaize, has been furnished by M. Ernest Chabrier, Civil Engineer, who has specially studied the system during the last ten years:—

The length of the line is 60 kilometres, or say 37½ miles, of which one-half is laid on the high roads. The capital is 48,000*l.* The Government and the Department jointly subsidised the Company to the extent of 52,000*l.*, and granted a concession as for a railway of local interest, of which full particulars are hereafter given. The gross receipts are 320*l.* per mile.

The rate for fully loaded waggons is 2*d.* per ton per mile.

The line is not yet completed, and its profits are employed in its extension.

The difficulties of steep gradients were surmounted by making deviations across the fields or open country.*

Farmers who require sidings and branch lines pay a sum down of 200*l.* to 240*l.*, and also all expenses of plant and laying; the length of the junction-line is added to the distance for the mileage tariff.

Special tariffs are arranged for cereals, cattle, meat, milk, miscellaneous articles, butter, cheese, poultry, hay, straw, artificial manures, oilcake, chalk, lime, sand, clay, marl, &c.; but at the present time the working of the line depends mostly upon the exportation of district produce. The goods imported consist of articles of daily consumption, such as wine, groceries, &c.

The cost of the railway stock came to from 320*l.* to 368*l.* per mile.

The construction of the line has been much delayed, owing to

---

* This seems an exception to the rule of the Government Engineers, *vide* Specification.

the difficulties with the local authorities, who, by the way, are all provided with free passes.

The speed of the trains is from $9\frac{1}{2}$ to $12\frac{1}{2}$ miles per hour.

Neither farm- nor carriage-horses take fright at the engines after they have seen them a few times. Some precautions are necessary at first.

The ordinary coach-brake is the only one used at present.

On farms where machinery is used, the farmers soon had sidings made; but farmers, as a body, have not used the railway much yet, though they appreciate its advantages.

Steel rails are used, weighing 50 lbs. per yard run.

Up to the present time it is calculated that every inhabitant of the districts where the rails are laid has been a passenger five times.

A telegraph is being organized as for an ordinary railway.

No note has been taken of the maximum curve, but the minimum is 54·6 yards radius.

The locomotives weigh 15 tons, and are on Mallet's compound system, and are fed from reservoirs on the line.

No special mechanical means have been devised for loading and unloading the trucks up to the present, nor are the passenger-carriages yet warmed in winter.

The following information is supplied by Monsieur Lavalard, Administrator of the Compagnie Générale des Omnibus de Paris, which owns 16,000 horses, and seems likely to absorb all the small tramway services of the Department of the Seine.

The capital of a Company for making a small narrow gauge railway on the high roads may be taken at 200,000*l.*: but the amount depends, of course, upon the length of the line and its branches. Debentures may be issued for the construction of small branch lines.

After allowing for all eventual and incidental expenses, 7 to 8 per cent. should be the return to the shareholders.

The tariff for the conveyance of goods must depend upon the traffic. Where it is considerable, rates should be low; but high where it is scarce.

Subsidies are rare, and when given, are more onerous than productive. Generally royalties must be paid, as, for instance, by keeping the roads in order; but it is certain that unless a monopoly of the road be given to the working Company, so that the chance of a fair income may be secured, no service can be regular or well-conducted.

We lay our rails on longitudinal sleepers. No cross sleepers are used.

The gauge of our line is 4 feet $8\frac{1}{2}$ inches, and the rails are juxtaposed, one in steel the other in iron.

The laying of the rails, whether in town or country, must be approved by the Service of Bridges and Roads (Ponts et Chaussées).

No payment is made for privileges; but the Company has always many obligations toward the State, the Department or town, and the public generally.

The documents printed on the subject of concessions and obligations are innumerable. (N.B. An example is given at the end of the paper.)

When steep gradients occur on the high roads they must be make the best of; there is no way of getting round them without losing the concession.

In Paris there are branch lines into all the Companies' depôts, and forage carts run on the rails as well as on the passenger-cars, but only for the Company's use at present.

In the Department of the Seine we have not yet established any tariff for goods or farm produce, nor have we established any private sidings or branch lines up to the present time.

The cost per mile of laying down lines on the high roads varies considerably, say from 5369*l.* at Nancy for single lines, to 20,790*l.* at Paris, for the North Tramway Company's *double* lines.*

The prices of rolling-stock, engines, horses, trucks, cars, &c., per mile, also vary much.

The following figures will give an idea :—

Laying the line costs say	72·66	per cent.
Land, Building, Machinery	9·93	„
Office furniture	0·23	„
Rolling Stock	6·90	„
Horses	0·68	„
Harness, Carriages, &c.	0·58	„

There are frequent disputes with the local authorities, and a large number of free passes are given.

The speed of the trains is from $7\frac{1}{2}$ to $9\frac{1}{2}$ miles per hour by horse traction. Accidents will, however, occur, and are the source of much trouble and expense. We are studying the question of a good brake.

Farmers are likely to be favourably disposed to cheap modes of traction; but the advantage must be brought before them frequently. The price of provisions has undoubtedly been equalised by the use of narrow gauge railways.

For the future we shall use all steel rails. We use no telegraph nor telephone at present.

* This Tramway Company pays no dividend to its shareholders.

Our omnibuses and tramways in Paris have carried 170,000,000 passengers per annum.

Our curves are of small radius at the terminus, where the cars turn round; one wheel runs loose and two wheels are flanged. The rails are laid in a double loop at the terminus.

We have not yet decided upon any type of traction-engine, and have no special means of loading or unloading, and do not warm the carriages in winter.

The following description of the secondary line laid by His Grace the Duke of Buckingham has been kindly furnished by Mr. Oxley, of Buckingham:—

On the Wootton Light Railway.

"This railway was constructed in 1871 for His Grace the Duke of Buckingham and Chandos. It is eight miles long, and effects a junction with the Buckinghamshire Railway at Quainton Station. The latter railway belongs to an independent company, and is worked by the Great Western Railway Company.

"The railway consists of a main line from Quainton to a point not far from the village of Brill, $6\frac{1}{4}$ miles long, and of a branch $1\frac{3}{4}$ miles long, joining the main line close to Wootton Mansion, and ending at Moate Farm. The whole line is constructed on land belonging to His Grace the Duke, save in the case of one or two fields.

"The sleepers are longitudinal, $6'' \times 6''$, and about three-fourths of the lot are of that description of Norway timber, known in London as 'die square,' as well as by being cut from whole trees; the quality is extremely tough; it is creosoted with 8 to 10 lbs. weight of oil per foot cube, and was delivered at Quainton at 1*s.* 10*d.* per foot.

"The transoms are $4'' \times 4''$, and have been generally cut from the waste elm and other timber of the demesne, and have been pickled in a solution of corrosive sublimate, which latter process so hardened the wood that it was found difficult to drive the tie-rod staples. All timber used on the estate for purposes of construction is prepared in this way, by special wish of His Grace the Duke, whose experience of it is favourable. The longitudinals are connected at their ends by flat iron dowels, $3\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{1}{8}''$, driven in edgeways, two to each joint. The gauge is preserved by the transoms being secured in position by wrought-iron tie-rods, having a nut and washer at each end, the connection between the transom and longitudinal being a plain butt joint, there being one tie-rod to each transom, to which the rod is held by two staples.

"The ballast is 15″ deep, 9″ of which is 'bottom ballast'—it consists in part of rough gravel, obtained at a few miles distance—and in part of 'burnt ballast' prepared on the spot, the ground here being the Oxford clay, full of fossil ostreas of large size.

"The line is practically a surface line, its few cuttings and embankments in no instance exceeding 10 feet in height.

"There are no bridges, all the roads, five in number, being passed by level crossings.

"The culverts are of earthenware pipes; the drain-pipes are of the same material, but of smaller diameters than those used for the culverts.

"The fencing consists of hurdles made from waste timber grown in the demesne woods, and is of a common and primitive description, having cost about 1*s.* per yard forward.

"The rails are of the bridge pattern, weight 30 lbs. per yard, and were

rolled by Messrs. Townsend, Wood and Co., Briton Ferry, South Wales; the price was 8*l.* 2*s.* per ton delivered at Quainton Station; they are fastened to the sleepers by fang bolts; a fishing-piece of oak, 8 inches long, connects each pair of rails at the ends; it is fitted into the hollow of the rails.

"The 6″ × 6″ longitudinal sleepers and 30-lb. rail, fastened together by fang bolts, makes in practice a way sufficiently stiff for the work done; the bearing surface is found to be ample for the maximum load pulled, which is theoretically not to exceed $2\frac{1}{2}$ tons per wheel. The waggons are those in ordinary use on the English railways, say of $3\frac{1}{2}$ tons weight average, and carrying 6 to 7 tons of freight each. As a matter of fact, waggons weighing over 5 tons each, and carrying 10 tons of coal, do occasionally run over the line, showing nearly 4 tons of weight per wheel total, instead of the theoretic $2\frac{1}{2}$ tons.

"The gradients are excellent and the curves fair; the steepest gradient is 1 in 50 for a length of a quarter of a mile, the rest vary from 1 in 100 to 1 in 800.

"The cost of the railway was 1400*l.* per mile, exclusive of land.

"The revenue at present is about 50*l.* per week.

"The traffic, so far, is chiefly in goods, coal, chalk and manure for the farms, and agricultural produce generally, including felled timber; passenger traffic hardly can be said to exist.

"The haulage for the first year was done by horse-power, but is now conducted by Aveling and Porter's (Rochester) locomotive engines, speed 6 miles the hour, weight 9 tons in steam, and having only a single cylinder, the driving wheels being worked by an endless chain from the fly-wheel shaft.

"The cost of each engine, of which the number found necessary is two, was 400*l.* delivered at Quainton.

"Before the introduction of the steam engines two horses could pull three ordinary loaded waggons over any part of the line, except on the gradient of 1 in 50, upon which two horses could pull but one waggon.

"The Duke would not allow any gauge to be adopted but that of 4′ $8\frac{1}{2}$″, the standard gauge of the country. The heavy locomotive engines of the lines adjoining are not allowed to run in upon the tramway.

"The *terrain* of the railway is a valley of the *cul-de-sac* type, Quainton Station lying at the open end, and the Brill terminus at the head of the valley, at an elevation of about 100 feet above Quainton. The village of Brill is at a much higher elevation, and lies at about three-quarters of a mile from the terminus.

"The railway is axial in its relation to the valley. Wootton Mansion, one of the residences of the Duke, rests close to the railway at four miles distance from Quainton, and is surrounded by pleasure grounds, woods, and shrubberies, with lakes of large size hard by. His Grace has not hesitated to carry the line in close proximity to the mansion, and it crosses two of the avenues.

"The sides and, in places, the bottom of the valley are occupied by the numerous farms belonging to the Wootton estate; they are generally of the grazing class, each with its picturesquely situated dwelling-house, offices, and plantations.

"The staple articles of production on these farms are butter and milk. Immediately after the completion of the railway large milk vans were placed on the route by the London and North-Western Railway, in order to bring these rich milk and butter producing districts into immediate connection with London. These milk-vans are run every day into the Broad Street Station of the London and North-Western Railway, a point only a quarter of a mile distant from the Bank of England.

"His Grace the Duke took a warm interest in the construction of this railway, and, doubtless, much of the economy attending it is due to the continual supervision exercised by himself.

"He has, in several instances, designed the modes of construction adopted; for instance, the pattern of rail and permanent way is entirely of his own choosing. He possesses much engineering taste and ability, and has had a large experience in the construction and management of railways, acquired during his Chairmanship, for many years, of the London and North-Western Railway, when Marquis of Chandos."

The work is of a more solid and therefore more expensive character than that advocated by me for ordinary cases. At the same time, where the traffic justifies the expense and money can be had at cheap rates, it is more economical to lay the permanent way well at the outset, for the interest on the additional outlay for good work is far less than the cost of constant repairs attendant upon rough-and-ready work.

Even if it can be foreseen that traffic is likely to increase permanently, it is well to lay a good road and pay off by a sinking-fund the additional expense.

In the Paris roads the rails laid upon longitudinal sleepers or ballast are always going at the joint, apart from settlements and upheavals; and where the original horse traction has been replaced by steam engines the repairs have become almost disastrous in their frequency and cost.

The agricultural line laid by Colonel Tomline from Felixstowe to Ipswich should also be described; to my regret, I have not been able to obtain any details thereon, nor upon that laid on the high road between Milan and Bergamo by Mr. Pistorius, a German gentleman who holds a direct personal concession; but it is understood that the latter works most successfully as a commercial speculation.

During the preparation of this paper the Editor communicated to me the following note by Mr. A. Percival Heywood, which will be read with interest.

Comparative Estimate of Haulage by Steam on Light Railways and by Horses on Roads.—This estimate does not pretend to deal with other than general cases. Special circumstances may cause either steam or horse-power to be clearly advisable, without a doubt arising as to which of the two is most suitable. But the cases here dealt with are those of places (of whatever class) which require to transfer a large quantity of goods or material to a definite other place, between which roads may be supposed to exist, but not railways; and the object of the writer is to show for how small a traffic a light railway will pay better than horse-and-cart haulage.

A locomotive being capable of working on the average about 250 days in the year, is able, however small it be, to move a very large tonnage in that time: therefore, the smallest locomotives and lightest lines only will be considered.

Although the writer has experimented with success on a line of only 15 in. gauge, with a locomotive weighing 1 ton, the waggons being even capable (on 4 wheels only) of containing as much as 25 cwt. of heavy material, such as lime or sand, yet he would advocate as the smallest advisable gauge one of 18", so successful at Crewe, Woolwich, and Chatham. The floor area (inside)

of the largest 4-wheeled waggon admissible on this gauge will be taken at 3′ 6″ × 7 ft. but preferably at the proper proportion of 3 ft. × 6 ft., and the loads at a maximum average of 1 ton; the locomotive weighing 2 tons, with 4½″ cylinder, and capable of hauling net loads of mineral (*i.e.* paying loads) of 7 tons up gradients of 1 in 50, and a proportionate number of cubic feet of bulky goods. Three times this load would be hauled on the level—say 20 tons, but light railways being seldom level, and the locomotives being seldom fully loaded, an average paying load of 5 tons will be taken as being about correct.

The loading and unloading costing in all cases about the same, the haulage only will be considered, and that only in the direction in which it is heaviest, the lighter return load having clearly no bearing on the comparison.

A distance of one mile between the two points will be taken as about what is usually required; although the relative cost will not very materially differ if the distance be two or three miles; the longer distance, however, being slightly in favour of the locomotives.

The railway is supposed to pass along the sides of roads, or over fields, the line being unfenced and carried through hedges in such a way as to be no impediment to the train, whilst preventing the passage of cattle. (The writer has some such railway cattle "stops" on his own line.) No allowance has been made in the comparison for way-leave or for land requiring to be bought, as in many cases the land is owned by the constructor of the line: therefore, in cases where such expenses arise, they must be added to the cost of haulage by steam in the following estimates.

The cost of an 18″ gauge line will be about 10*s.* per yard run, complete; made up as follows:—

	s.
Earth-work (2 cubic yards per yard run) ..	2
Bridges (including cattle-stops)	1
Ballast	1
Rails (18 lbs. per yard, steel, with fish-plate)	3
Laying and spikes	1
Sleepers	1
Sundries	1
Cost per yard	10

The writer's line cost rather less than this, but it is lighter, and he sawed up his own timber for sleepers.

The cost of rolling stock would be—

	£.
Locomotives	250
12 Waggons at 8*l.*, say	100

And taking 2000 yards as equal to a mile of line (the extra amount being for sidings) the cost will be—

	£.
2000 yards of line	1000
Rolling stock	350

Add 150*l.* for extras, and the total equipment of a mile of line will amount to 1500*l.*

If we now take the engine as working 1 day a week, or say 50 days in the year for 8 hours a day, and making 1 trip every hour with a paying load of 5 tons, we shall have 40 tons moved per day = 2000 tons per annum. With a double set of waggons nearly as much again could be moved in the time; but the above is taken as average work, it being easier to work another day each week than to press more into one day.

The cost of hauling these 2000 tons will be as follows:—

	£
Interest on 1500*l.* at 5 per cent.	75
Renewal, repair of line and rolling stock, 15 years life on 900*l.*	60
Driver at 4*s.* per day, boy 2*s.*—50 days ..	15
Fuel and oil at 4*s.* per day—50 days	10
Cost of hauling 2000 tons 1 mile ..	£160

Cost per ton about 1*s.* 7*d.*

If the engine be worked 2 days a week = 100 days a year, the expense will be much less, the interest on outlay being the same and the renewals but little increased.

	£
Interest	75
Renewals, &c., 14 yrs. life on 900*l.*, say ..	65
Driver and boy, 100 days	30
Fuel and oil ditto	20
Cost of hauling 4000 tons	£190

Cost per ton about 1*s.*

Now, 1*s.* per ton is about the cost of haulage by road, and therefore it would appear that, speaking generally, it requires two days' work per week (or say from 4000 to 5000 tons, or equal proportions of bulky goods) before the outlay on a railway will repay itself. And it will be seen that the railway here estimated has been denuded of all collateral expenditure, viz., such as might arise from way-leaves, having to keep drivers employed on other days, and so forth. Also horses and carts can be turned to other purposes when required; and railways and rolling stock degenerate almost as fast when unused as when used, as the writer knows to his cost.

Note.—Such a line as the above, worked full time, viz., 250 days per year, will haul at about 5*d.* per ton per mile.

The German publication, 'Organ Für die Fortschritte des Eisenbahnwesens,' has published this year an interesting account of the construction and working of light railways on common roads, by Herr Buresch of Oldenburg, which is translated in the Abstracts of the Institution of Civil Engineers: where also can be seen the Report of Mr. C. E. Spooner of Portmadoc, North Wales, on Narrow Gauges; that of Captain Tyler on the Festiniog Railway; and a pamphlet on Light Railways and Tramroads, by Arthur C. Pain, C.E.

I wish to express my thanks to Monsieur Ernest Chabrier, C.E., Paris; Monsieur Lavalard, Administrator of the Compagnie Générale des Omnibus, Paris; Monsieur Orchampt, of Lille; and Mr. James Forrest, the Secretary of the Institution of Civil Engineers.

In conclusion, I venture to express the hope that the Council of the Royal Agricultural Society will see their way to offer a substantial prize for the best agricultural railway laid on a high road after two years at least successful working, and so stimulate the adoption of such railways as they did the cultivation of land by steam-power in 1861.

APPENDIX.

Documents relating to a Concession of Authority to lay a Narrow Gauge Railway on Common Roads in the Department of the Meuse.

AGREEMENT.

A.D. eighteen hundred and sixty-seven, October 10. Between M. Hippolyte Rousseau, Prefect of the Meuse, acting in the name and on the account of the Department of the Meuse, in pursuance of the decisions of the Council-General of the Meuse, held at the Meetings of August 20 and 21, 1875, on the one part; and M. Leon Soulié, civil engineer, residing in Paris, 96 Avenue de Villiers, acting on his own account, on the other part; it has been covenanted and agreed as follows:—

Article 1.—The Prefect of the Meuse concedes to M. Soulié above mentioned the narrow gauge railway to be laid down on the side-spaces of the high roads and ways of the Department of the Meuse, starting from Haironville, passing by or near Ville-sur-Saulx, Lisle-en-Rigault, Robert-Espagne, Beurey, Couvonges, Mognéville, Revigny, Brabant-le-Roi, Noyers, Auzécourt, Laheycourt, Villette-devant-Louppy, Lisle-en-Barrois et Vaubécourt, and terminating at Triancourt.

The whole in accordance with the clauses and conditions of the estimate annexed to the present treaty.

Article 2.—On his part, M. Soulié binds himself to construct and work the said railway referred to in the present concession within three years from the date of the approbation of the plan.

Article 3.—The party to whom the concession is granted will receive for the construction of this road a total subsidy of 55,066*l.* (fr. 1,312,667).

1. The Department will pay fr. 10,000 per kilometre (640*l.* per mile), and for the 61 kilometres forming the entire length of the line (24,400*l.*), fr. 610,000.

This sum will be paid in twelve parts, on the 1st of January and the 1st of July of each year, after the party who has obtained the concession shall have deposited the plans.

Nevertheless, neither of these payments will be made unless the contractor has proved that he has spent double the sum, either in the shape of works or of plant.

Besides, the Department will pay to the contractor a fixed sum of fr. 50,000 (2000*l.*), as an indemnity for all such works which will have to be done at such parts where the above-mentioned railway would be obliged to abandon the side-spaces of the high roads and ways, as well as for all other works for the purpose of access and of junction. This payment will be made on the same conditions and at the same dates as the preceding ones, viz.:—(2000*l.*) fr. 50,000.

2. Subsidy of the communes (parishes) ..	(1980*l.*)	..	fr. 49,500
3. Subsidy of manufacturing firms	(3500*l.*)	..	fr. 87,500
4. Land furnished by the parishes, valued at	(4480*l.*)	..	fr. 112,000
5. Subsidy applied for from the Government, by application of Art. 5 of the law of July 12, 1865	(16,146*l.*)	..	fr. 403,667

Article 4.—The person holding the concession will have the right, after obtaining a decree of public utility, of forming a limited liability company for the emission of stock, shares, and debentures. A company formed in this manner may take the place of the person holding the concession, and become jointly and severally responsible towards the Department for all the engagements which the said person may have entered into with the latter.

Article 5.—The present concession is made for ninety years from the date of opening of the entire line. At the expiration of the said term of years, the railway and its accessory parts, which must be in good working order, will become the property of the Department, and to that effect no indemnity whatsoever will be due to the company. As regards stock of materials and fuel, the Department will be held, if the company insists, to purchase all such materials at a price to be estimated by experts.

Article 6.—The present agreement is subject to the subsidy granted by Government being obtained, as stipulated by the application of the law of July 12, 1865. This subsidy will belong to the person obtaining the concession, as well as the sums which may be subscribed by the parishes and private individuals.

It remains understood that the land necessary for rectifications (crossing villages, changing directions), as well as for the construction of workshops, sheds, reservoirs, storing fuel and material, in conformity with the plans approved of by the Administration, will be supplied gratuitously by the contractors.

Article 7.—As the line referred to in the present contract is constructed experimentally, the Department will reserve to the contractor the preference on equal terms, and within a period of three years from the date of the signature of the present treaty, for any other narrow gauge railway which may ultimately be constructed, and particularly

1. A line from Void to Etain by Sorcy, Gironville, and Vigneulles.
2. From Vigneulles to Clermont-en-Argonne, by Saint-Mihiel, Chaumont-sur-Aire, and Bauzée.
3. From Bar-le-Duc to Verdun by Varincourt and Souilly.
4. From Void to Naix.

Article 8.—The costs of stamping and registering the present treaty and the estimate will be borne by the person obtaining the concession.

The contracting parties have attached their signatures hereto, after having read the same.

The Prefect of the Meuse.	*The Contractor.*
(Signed) H. Rousseau.	(Signed) L. Soulié.

OFFICIAL GAZETTE OF FEBRUARY 17, 1877.

Decree.

The President of the French Republic,

On a report of the Minister of Public Works,

Having taken into consideration the preliminary plans presented for constructing in the Department of the Meuse a railway for local use, and particularly the Official Report of the Committee of Inquiry, dated May 27, 1876,

Decrees:

Article 1.—It is declared of public utility to construct a narrow gauge railway for local service from Haironville to Triancourt, passing by or near Ville-sur-Saulx, Mognéville, Revigny-aux-Vaches, Noyers and Vaubécourt.

The present declaration of public utility will be considered as null and void if the necessary dispossessions (expropriations) for the execution of the above road are not accomplished within a period of four years from the date of the present decree.

Article 2.—The Department of the Meuse is authorised to attend to the execution of the present line as a railway of local interest, according to the stipulations of the law of July 12, 1865, and in conformity with the con-

ditions of the agreement passed October 10, 1876, with M. Léon Soulié, as well as with the terms of the estimate annexed to the said convention.

Certified copies of these agreements, and of the terms and conditions of the estimate, will be annexed to the present decree.

Article 3.—The Department of the Meuse grants from the funds of the Treasury, by application of Article 5 of the above-mentioned law of July 12, 1865, and on condition of the previous inscription thereof in the budget of public works, a subsidy of four hundred and three thousand six hundred and sixty-seven francs, fr. 403,667 (16,146*l.*).

This subsidy will be paid at six equal half-yearly periods, dating from January 15, 1878.

The Department must prove, before the payment of each instalment, an expenditure in the shape of purchase of land, works, and supplies on the spot, equal to three times the sum to be received.

The last payment will not be made until after the works have been completely terminated.

Article 4.—No issue of debentures will be allowed except on authority granted by the Minister of Public Works, in concert with the Minister of the Interior, and after the Minister of Finance has given his advice thereon.

In no case can debentures be issued for a sum exceeding the capital represented by the shares, which will be fixed at one-half of the expenditure which will be judged necessary, after deducting the subsidies granted by the State, the Department, the parishes, and private individuals, for the complete construction and the starting of the Railway; and this capital in shares must be effectively paid up; shares liberated or to be liberated will not be taken into consideration, otherwise than as money.

Nevertheless, no issue of debentures will be authorised before four-fifths of the capital in shares has been paid in and employed in the purchase of land, in works, in supplies on the spot, or deposited as a guarantee fund.

Nevertheless, the holder of the concession will be allowed to issue debentures when the whole of the capital in shares has been paid in, and if it be duly proved that more than one-half of the capital in shares has been employed in conformity with the terms of the preceding paragraph; but the funds arising from these anticipated issues must be deposited either in the Bank of France or in the Caisse des Depôts et Consignations, and will only be placed at the disposal of the possessor of the concession by a formal authorisation of the Minister of Public Works.

Article 5.—A detailed account of the results of the working, including the expenses of the cost of the line and of its working, and the gross receipts, shall be presented every three months to the Prefect of the Department, who will forward it to the Minister of Public Works for insertion in the 'Journal Officiel.'

Article 6.—The Minister of Public Works and the Minister of the Interior are each, insomuch as they are individually concerned, bound to attend to the execution of the present decree, which will be inserted in the 'Bulletin des Lois.'

Done at Versailles, February 8, 1877, *by the President of the Republic,* — MARSHAL MACMAHON, DUKE OF MAGENTA.

The Minister of Public Works,
ALBERT CHRISTOPHLE.

GENERAL CONDITIONS RELATING TO THE CONCESSION OF RAILWAYS OF LOCAL INTEREST.

I.—Laying out the Line and Construction.

Article 1. *Laying out.*—The narrow gauge railway of local interest from Haironville to Triancourt will pass by or near Ville-sur-Saulx, Lisle-en-Rigault, Robert-Espagne, Beurey, Couvonges, Moquéville, Revigny-aux-Vaches, Brabant-le-Roi, Noyers, Auzécourt, Laheycourt, Villotte-saint-Louppy, Lisle-en-Barrois and Vaubécourt, and will terminate at Triancourt.

It may follow the high roads, ordinary roads, and the departmental roads, on condition of leaving for ordinary wheels a free circulation of at least six metres (yards 6·56), reckoning from the extreme external parts of the machines or the waggons.

The rails will be laid on one of the sides of the road at such a distance from the extreme edge of the road as will be laid down in the final plans.

Nevertheless, on passing through towns and villages where the passage of the railway shall have been authorised, the line will generally occupy the middle of the road.

Wing rails will be laid down where the line crosses or meets roads or ways, and in all such other parts where the authorities may consider it necessary, either in the interest of public safety or for the service of adjacent property. . . . .

Article 4. *Previous Plans.*—The contractor will be allowed to copy, but without removing them, all the plans, levels, and estimates which may have previously been made at the expense of the Department. . . . .

Article 7. *Cross Sections.*—The width of the road between the internal edges of the rails is to be 1 metre (3′ 3⅜″). Where there is a double line, the width of the intermediate space, measured between the external edges of the rails, is to be one metre and eighty centimetres (1 m. 80) 5′ 13⅞″. . . . .

The width of the side-spaces—that is to say, of the parts comprised on each side, between the outer edge of the rail and the limit of the ballast, is to be two hundred and seventy-five millimetres (0 m. 275), viz., 11 inches.

The thickness of the layer of ballast is to be at least twenty-five centimetres (0 m. 25) 10 inches, and at the foot of each ballast slope a level place, fifty centimetres (0 m. 50) wide, 1′ 8″, must be reserved outside of the roads and ways.

In the parts of the railway situated on the side-spaces of roads and ways, the width between the external edge of the side-space of the road or of the highway and the outer edges of the rail is to be thirty centimetres (0 m. 30) at the least: 1 foot.

The sleepers are to be at least one metre fifty centimetres long (1 m. 50) 4′ 11″.

The holder of the concession must make along the line all such ditches and waterways as may be considered necessary for draining the road and for running off the water.

The dimensions of these ditches and waterways will be fixed by the Prefect, according to local circumstances, on the proposals made by the contractor.

Article 8. *Straight Sections and Curves ; Inclines and Gradients.*—Straight sections are to meet together by curves, the radius of which must not be less than 50 metres (yards 54·66). A straight section of twenty metres (yards 21·87) at least must exist between two consecutive curves, when the latter are in opposite directions.

The maximum declivity is fixed at thirty millimetres (11·81 inches).

A horizontal section of twenty metres (yards 21·87) at least must exist between two consecutive declivities in opposite directions.

Declivities corresponding with curves of a small radius must be reduced as far as it is possible.

The contractor will be allowed to propose such alterations as he may consider useful in reference to the stipulations of this article, as well as to those of the preceding one; but such alterations will only be carried out after having been approved of by the Prefect. . . . .

Article 9. *Passenger and Goods Stations.**—The number, extent, and situation of the sidings will be fixed by the Prefect, after having heard the party holding the concession.

Article 19. *The Road.*—The roads are to be built in a solid manner, and with materials of good quality.

The weight of the rails is to be fourteen kilogrammes (30·8 lbs.) in Bessemer or other steel, and sixteen kilogrammes fifty grammes (35·25 lbs.) in wrought iron per metre run on all such parts where the traffic takes place.

The maximum distance from sleeper to sleeper is to be one metre—3′ 3⅜″.

Article 20. *Fences.*—The contractor is not compelled to place fences and gates on the entire length of the line forming part of the present concession.

Article 21. *Indemnities for Land and Damages.*—All the land necessary for the railway and its connections, for deviating roads and ways, and for displacing waterways, and in general for the execution of the works of whatever nature they may be, will be furnished gratuitously to the holder of the concession.

All indemnities for temporary occupations or for deterioration of land, stoppages, altering or destroying works, and for all other damages resulting from the building of this line, will be due and must be paid for by the holder of the concession.

Article 22. *Rights conferred upon the Holder of the Concession.*—As the undertaking is for public utility, the contractor is invested, for the execution of the works depending on his concession, with all the rights that the laws and regulations confer upon the Administration in reference to public works, either for the acquisition of land (by expropriation) at a jury's estimate, or for the extraction, carriage, and deposit of earth and materials, &c.; and he remains at the same time subject to all the obligations which are derived, for the Administration, from these laws and regulations.

Article 27. *Control and Inspection of Works.*—The works will be carried on by such means and such agents as the holder of the concession may select, but they will be subject to the control and inspection of the Prefect.

The purpose of this control and inspection is to prevent the contractor from eluding the stipulations and clauses prescribed in the present estimate, as well as those which will be set down in the plans approved of.

Article 28. *Reception of the Works.*—As the works will be successively terminated on such parts of the line as can usefully be opened to the traffic, on the demand of the contractor they will be duly inspected, and, if required, they will be provisionally received by one or more commissaries designated by the Prefect.

On the presentation of the document concerning this inspection, the Prefect will authorise, if advisable, the opening of such parts of the line. After such authorisation, the contractor will be allowed to open such parts for traffic and to receive the fares as hereafter mentioned. Nevertheless, these partial receptions will only become definitive on the general and definitive reception of the railway.

---

* The conditions stipulated for in the preceding clauses and conditions have been suppressed.

II. Keeping in Repair and Working.

Article 30. *Keeping in Repair*—The railway and all its supplementary works must be constantly maintained in good order, in such a manner that the traffic will always be easy and safe.

The costs of keeping in repair, as well as those incurred for ordinary and extraordinary repairs, will be entirely defrayed by the holder of the concession.

If the railway, when finished, is not constantly kept in a good state of repair, it will be done by order of the Administration, and at the expense of the party holding the concession, notwithstanding which, as the case may be, the dispositions hereafter referred to in Art. 40 may be applied.

The amount of advances made may be recovered (collected) by means of writs (*rôles*) which the Prefect will cause to be executed.

Article 32. *Rolling Stock.*—The locomotives must be built after the most approved models; they must consume their smoke, and answer in all respects to the conditions laid down, or to be laid down, by the Administration for controlling the use of this kind of machines.

Passenger carriages must also be built after the most approved models, and must satisfy all the conditions laid down, or to be laid down, for vehicles serving for transporting passengers on railways. They must be suspended on springs and provided with cushions, and they may be provided with an upper story.

Article 33.—The Prefect will decide on the proposal of the contractor, the minimum and maximum speed of passengers' and goods' trains, as well as the duration of the journey. The number of passenger trains stopping at all the stations and places of call will not be less than two a day in each direction; these may be mixed trains.

III. Duration, Redemption, and Forfeiture of the Concession.

Article 35. *Duration of the Concession.*—The duration of the concession for the narrow gauge railway of local interest, mentioned in Art. 1 of the present spectfication of charges, will commence on the day of the opening and working of the entire line. It will terminate ninety years after the said date.

Article 36. *Expiration of the Concession.*—At the date fixed for the expiration of the concession, and by the sole fact of such expiration, the Department will be entitled to all the rights of the party holding the concession on the railway and its connections, and will enter into immediate possession. . . . .

The authorisation conceded in the first Article, of building the whole or a part of the road on the high roads and ways, may be entirely or partially withdrawn before the time fixed in the specification of clauses and charges in the forms followed for the concession, whenever the necessity thereof has been recognised by the Administration, after an inquiry has been made in the public interest.

In case the concession is withdrawn on account of the motive above mentioned, the contractor will be entitled to the reimbursement of all useful expenses he has incurred in the construction of the line.

Article 37. *Redemption of the Concession.*—At any time after the expiration of the first twenty years of the concession, the Department will have the option of redeeming by purchase the entire concession of the railway.

In order to estimate the price of this purchase, there shall be drawn up, &c. . . . .

IV. Taxes and Conditions relating to the Carriage of Passengers and of Goods.

Article 42. *Tariff of Dues to be collected.*—In order to indemnify the holder of the concession for the works and expenditure which he binds himself to make under the present schedule of charges, and under the express condition that he will fulfil exactly all their obligations, the Department grants to him the authorisation to collect, through the entire duration of the concession, the passenger fares and freight dues hereinafter set forth.

Tariff.

1. *Per Passenger and per Kilometre.**

	Prices.		
	Fare.	Carriage.	Totals.
Express.			
Passengers—			
Covered carriages, stuffed and glazed (1st Class)	*d.* 1	*d.* $\frac{1}{2}$	*d.* $1\frac{1}{2}$
Covered carriages, glazed and cushion-seated (2nd Class)	$\frac{67}{100}$	$\frac{32}{100}$	1
Children—			
Under three years no charge will be made, on condition that they sit on the laps of the parties accompanying them.			
From three to seven they will pay half-price, and are entitled to a distinct place; nevertheless, two children in the same compartment will only be allowed to occupy the place of one passenger; over seven years they will pay full fare.			
Dogs carried in passenger trains	$1\frac{3}{10}$	$\frac{7}{10}$	2
The whole sum paid must not be less than 5*d.*			
Ordinary Freight Trains.			
Oxen, cows, bulls, horses, mules, draught animals	$\frac{8}{10}$	$\frac{4}{10}$	$1\frac{2}{10}$
Calves and pigs	$\frac{34}{100}$	$\frac{16}{100}$	$\frac{1}{2}$
Ewes, sheep, lambs, goats	$\frac{15}{100}$	$\frac{1}{10}$	$\frac{1}{4}$

When the above-named animals are transported on the demand of the senders in a passenger train, these prices will be doubled.

* Five kilometres are equal to about three English miles.

2. *Per Ton and per Kilometre.*

	Prices.		
	Fare.	Carriage.	Totals.
GOODS CARRIED BY FAST TRAINS (GRANDE VITESSE).			
Oysters, fresh fish, provisions. Excess of baggage or of goods of any class transported at the same speed as passenger trains	*d.* $3\frac{2}{10}$	*d.* $2\frac{8}{10}$	*d.* 6
GOODS CARRIED AT LOW SPEED (PETITE VITESSE).			
1st Class— Spirits, oils, carpenters' work, dye-woods, fancy woods, chemicals not denominated, eggs, fresh meat, game, sugar, coffee, drugs, groceries, tissues, spices, and other colonial goods, manufactured articles, arms	$1\frac{1}{10}$	$\frac{9}{10}$	2
2nd Class— Corn, seeds, flour, farinaceous vegetables, rice, Turkish corn, chestnuts, and other articles of food not denominated, lime and plaster, charcoal, timber for fuel, rods, rafters, planks, beams, timber for heavy carpentry, blocks of marble, alabaster, bitumen, cotton goods, woollen goods, wines, vinegars, beverages, beers, dry yeast, coke, irons, copper, lead, and other metals worked or unworked, cast iron moulded	$1\frac{1}{10}$	$\frac{9}{10}$	2
3rd Class— Stone for building purposes and the produce of quarries, ores other than iron ores, cast iron in the rough, salt, rubble stone, millstone, clays, bricks..	$1\frac{1}{10}$	$\frac{9}{10}$	2
4th Class— Slates, coal, chalk, cinders, manures, dung, lime and plaster stones, paving stones and materials for building roads, iron ore, gravel and sand ..	$1\frac{1}{10}$	$\frac{9}{10}$	2
GOODS OF ANY CLASS TRANSPORTED PER LOADED WAGGON	$\frac{7}{10}$	$\frac{1}{2}$	$1\frac{2}{10}$

3. *Vehicles and Rolling Stock carried by Freight Trains.*

Each per Kilometre.

	s.	*d.*	*s.*	*d.*	*s.*	*d.*
Waggon or coach holding 3 to 6 tons	0	$2\frac{7}{10}$	0	$2\frac{3}{10}$	0	5
" " more than 6 tons	0	$3\frac{2}{10}$	0	$2\frac{8}{10}$	0	6
Locomotive weighing from 12 to 15 tons (unconnected with a train)	1	6	1	0	2	6
Tender, 7 to 10 tons	0	9	0	6	1	3
Tender, weighing more than 10 tons	1	1	0	9	1	10
Locomotive engines will be considered as not drawing a train, when the train being drawn, whether a passenger or a goods train, does not produce a payment or fare at least equal to that which would be charged for a locomotive, and its tender circulating without a train.						

3. *Vehicles and Rolling Stock carried by Freight Trains—continued.*

Each per Kilometre.

	Prices. Fare.		Carriage.		Totals.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*
The price to be paid for a loaded waggon shall never be less than such as would be paid for an empty waggon.						
Two- or 4-wheeled carriages, with a bottom and a single cushion or seat within	0	$3\frac{2}{10}$	0	$2\frac{8}{10}$	0	6
Four-wheeled carriages, with double bottom and two seats within, omnibuses, stage coaches, &c...	0	$4\frac{2}{10}$	0	$3\frac{8}{10}$	0	8
When at the request of the senders, these articles are transported at the same speed as passenger trains, the above prices will be doubled.						
In this case, two persons may without extra charge travel in the carriages with one seat, and three in the coaches with two seats, omnibuses, stage coaches, &c.; passengers exceeding these numbers will pay the tariff at second class rates.						
Empty furniture vans on 2 or 4 wheels	0	$3\frac{2}{10}$	0	$2\frac{8}{10}$	0	6
When such vans are loaded, they will pay an extra price per ton load and per kilometre	0	$1\frac{35}{100}$	0	$1\frac{15}{100}$	0	$2\frac{1}{2}$

4. *Burial Services and Carriage of Coffins.*

Express (*grande vitesse*).

	d.	*d.*	*s.*	*d.*
A funeral or mourning coach, containing one or several coffins, will be transported at the same charges and on the same conditions as a 4-wheeled coach, double-bottomed, and with two seats ..	$8\frac{7}{10}$	$7\frac{6}{10}$	1	4
Each coffin confided to the Administration of the railway will be carried, for ordinary trains, in an isolated compartment and charged	$2\frac{7}{10}$	2	0	5
And by express trains in a special coach, charged	6	4	0	10

The above-mentioned tariffs do not include the tax due to the Government.

Unloading and loading at the junctions with the Eastern Railway Company will be paid by the holder of the concession, it being understood that they cannot in any case be charged to the senders or receivers.

It is to be expressly understood that the carriage or freight charges will only be due to the holder of the concession in so far as he effects himself these transports at his own expense and by his own means; if such is not the case, he will only be entitled to the prices stated as fares.

The tariff will be enforced according to the number of kilometres travelled. Every kilometre commenced will be reckoned as if it had been entirely travelled over.

If the distance travelled is less than six kilometres (miles 3·75), it will be reckoned at six kilometres.

The weight of a ton is 1000 kilogrammes.

Fractions of weight will be taken into account, as well on fast as on slow trains only as hundredths of a ton, or by 10 kilogrammes at a time.

Thus any weight ranging from 0 to 10 kilogrammes will be charged as 10

kilogrammes, and between 10 and 20 kilogrammes, as 20 kilogrammes, and so forth.

Nevertheless, for excess of baggage and goods per fast trains, fractions will be reckoned (1) 0 to 5 kilogrammes; (2) above 5 up to 10 kilogrammes; (3) above 10 kilogrammes per undivided fractions of 10 kilogrammes.

No goods or packages will be charged less than 6*d.*, whatever the distance travelled over may be, whether by fast or by slow trains.

Article 43. *Composition of the Trains.*—Except by a special authorisation (which may be revoked) of the Prefect, every regular passenger train must contain carriages or compartments of all classes in sufficient number for all the persons who may present themselves at the offices of the railway.

In each passenger train the holder of the concession will be allowed to place carriages with special compartments, for which special prices will be charged at a rate to be fixed by the Prefect at the request of the holder of the concession; but the number of places in these compartments must not exceed one-fifth of the total number of places in the train. The holder of the concession may reduce by 20 per cent. the fare from one section of the line to another for return tickets available for one or two days.

He will be allowed to organise excursion trains, he may also grant season tickets available for six or for twelve months, at reduced prices, which will be submitted for the approbation of the Prefect.

Article 50. *Times for Delivery.*—The Prefect will fix by means of special regulations and on the request of the holder of the concession—

1. The number of day trains to travel on the railway.

2. The times of starting and arrival of each of these trains, as well as their speed.

This speed shall not exceed twenty kilometres an hour (12·5 miles), and must be reduced when passing inhabited localities and in the case of stoppages on the road.

The holder of the concession cannot be compelled to provide any night service.

Article 51. *Accessory Expenses.*—The accessory expenses not mentioned in the tariffs, such as those for registration, loading, unloading and warehousing in the stations and warehouses of the railway station, dues on starting and on arrival, will be fixed annually by the Prefect at the request of the holder of the concession.

Article 52. *Carting.*—Loading and unloading will be done by the senders or receivers, they will also do their own porterage and carriage.

Article 58. *Telegraphic Apparatus for the Service of the Railway.*—The holder of the concession may be authorised by the Minister of Public Works acting in concert with the Minister of the Interior, to erect at his own expense the wires and telegraphic apparatus for the purpose of transmitting the necessary signals for the safety and regularity of the working of the railway.

He may, with the authorisation of the Minister of the Interior, make use of the posts of the Government telegraphic line, where such a line exists on the railway.

The holder of the concession will be bound to submit to all the rules of the public Administration in respect to the laying down and the use of such apparatus, as well as to the organisation, at his expense, for the control of this service by the agents of the Government.

The telegraphic offices established in the stations will be placed at the disposal of the public, if the Administration comes to such a decision, and in such case it will lay down rules and regulations.

VI.—Various Clauses.

Article 62. *Industrial Branch Lines.*—The holder of the concession will be bound to come to an agreement with any or every proprietor of mines, works, or farms who may offer to submit to the conditions hereafter enumerated, with the view of having a branch line; should they fail to come to an agreement, the Prefect will decide as to the demand made, after having heard the statement of the holder of the concession.

Branch lines will be constructed at the expense of the owners of the mines, works, or farms; and in such a manner that their construction shall not give rise to any impediment to the general circulation or traffic, to any destructive action to the stock, nor to any special expenses to the company.

They must be kept in good repair at the expense of the owners and under the control of the Prefect. The holder of the concession will have the right of inspecting by his agents the state of such branch lines, as well as that of his rolling stock on the same.

The Prefect may at all times prescribe such alterations as may be considered useful in respect to the junctions with, and the laying out and construction of the said branch lines, and such changes will be made at the expense of the owners.

The Prefect may, even after hearing the opinion of the owners, order that the junction switches be temporarily taken up, in case the works thus connected with the main line should suspend partially or entirely the carriage of their goods by the railway.

The holder of the concession will be bound to send his waggons on all the authorised branch lines destined to put mines and works in communication with the main line of railway.

The holder of the concession will bring his waggons to the head of the branch lines.

The senders or receivers will run the waggons in their works for the purpose of loading and unloading, and bring them back to the junction with the main line, all at their own expense.

These waggons may only be used for the carriage of articles and goods destined for the main line of railway.

The time during which the waggons may remain on the private branch lines shall not exceed six hours when the branch line is not more than one kilometre long. This time will be augmented one half-hour for each kilometre, exclusive of the hours at night-time, from sunset to sunrise.

In case these limits of time are exceeded, after a special notification being given by the holder of the concession, he may claim an indemnity equal in value to the hire of the waggons for each period of delay after the notification.

The salaries of the employés of these branch lines authorised by the Prefect will be paid by the owners of the branch lines. These employés will be named and paid by the holder of the concession, and the expenses arising therefrom will be reimbursed to him by the said owners.

In the case of any misunderstanding, the case will be decided by the Administration, after hearing the statement of the holder of the concession.

The owners of the branch lines will be responsible for any injuries to the rolling stock whilst it is running or remaining on their lines.

In case of the non-execution of one or several of the conditions as above laid down, the Prefect may on the complaint of the holder of the concession, and after having heard the owner of the branch line, make out an order for suspending the service and for suppressing the junction, with the option of a recourse to the superior Administration, and without prejudicing the right of claiming damages which the holder of the concession may enforce for the non-execution of these clauses.

Tariff to be levied for the loan of Rolling Stock.—To indemnify the holder of

the concession for supplying and sending his rolling stock on the branch lines, he is authorised to levy a fixed sum of $1\frac{1}{2}d.$ for every ton for the first kilometre, and further $\frac{6}{10}d.$ for every ton per kilometre in addition to the first one, when the length of the branch line exceeds one kilometre.

Every kilometre commenced will be paid for as if travelled over on its entire length. The holder of the concession will besides levy a fixed branch line tax of $2\frac{1}{2}d.$ per ton ; *from this tax may be exempted the owners of works and mines who have contributed by a subsidy, accepted by the Prefect, to the construction of the line, after he has heard the statement of the holder of the concession.*

Loading or unloading on the branch lines will be paid for by the senders or the receivers, whether they do this work themselves or the railway company consents to do it for them.

In this latter case, the expenses will be subject to a tariff established by the Prefect at the request of the holder of the concession.

Every waggon forwarded by the holder of the concession on a branch line must be paid for as being completely loaded, even if it is not completely loaded.

The extra load, if any, will be paid for according to the legal tariff, and at the *pro rata* of the real load ; the holder of the concession may refuse any load which exceeds the maximum of three thousand five hundred kilogrammes ($3\frac{1}{2}$ tons), which is the load fixed as regards the actual dimensions of the waggons.

The maximum will be revised by the Prefect so that it shall always bear a proper relation to the capacity of the waggons.

XXV.—*On the Modes of Culture and Preparation of Flax, as practised in Ireland and on the Continent.* By MICHAEL ANDREWS, Secretary of the Flax Supply Association for the Improvement of the Culture of Flax in Ireland.

AT the present time when agricultural operations in the United Kingdom are, owing to foreign competition and unfavourable harvests, becoming less remunerative than formerly, it behoves the farmer to seek some more profitable crop than he has hitherto admitted into his rotation. With regard to cereals, it is pretty generally admitted that foreign countries can produce them cheaper than can be done in the United Kingdom, even with the advantage of the facilities derived from the use of steam-power as a substitute for manual- and horse-labour. Hops only flourish in certain localities that are congenial to their growth, and they also have strong rivals to contend with abroad, and are at home burdened with heavy imposts. The revival of tobacco culture has been recently mooted, but this crop is not likely to take root in Great Britain.

The cultivation of flax has been attended with considerable success in the province of Ulster in Ireland ; it is peculiarly adapted to a temperate climate, and when carefully grown and judiciously handled is a paying crop. On the Continent, the

growth and after-preparation form distinct industries, but this is not so in Ireland, where the farmer not only grows the crop, but also manipulates it after it has been pulled. The several operations require careful attention and a certain amount of skill, but are not intricate; and the Irish system has the advantage of securing to the farmer, not only the profit attending the agricultural department, but also that of preparing the fibre for market.

The purpose of the present paper is to give in detail particulars regarding the nature of the soil best suited to the crop, the most judicious mode of preparing the land for the reception of the seed, the treatment of the crop while growing, and, finally, its removal from the soil and after-preparation; and it may be added that experience has proved that by following the directions given the casualties attending the culture of flax are lessened, and that, under average circumstances, remunerative crops may be produced.

With every farmer the first consideration should be, is the land he holds suitable to produce a profitable crop of flax, and if the necessary facilities for watering can conveniently be had? Land intended for flax must be in good condition and clean.

Peaty land where a clay bottom does not exist, also sandy land with a gravelly bottom, are unsuitable for flax, and a small yield and poor fibre may be expected if it is grown in such soils. Medium and alluvial soils are the most suitable, and in average seasons are easily brought into a proper state of tillage to receive the seed. On heavy land, if the season is favourable for pulverising the ground, crops of flax rich in fibre will be produced—of course assuming in all cases that, where requisite, the land has been properly drained. It is impossible to convey, in a paper such as this, a proper idea as to every variety of soil that would be likely to give a good crop, but it may be remarked that land in "good heart" will produce the best yield and the fibre will be of superior quality; poor land will produce a weak fibre. In selecting land for flax, it is desirable to have it as flat as possible, with a cool bottom; hilly land will not produce flax of a uniform reed.

A very important matter in flax culture is to determine what extent of a farmer's holding it is proper and judicious for him to appropriate to flax, as it is a well-known fact that flax should not be sown in the same land without allowing an interval of years to elapse. Much also depends upon the capability of keeping up the condition of the land. A progressive scale might be adopted—say on farms up to thirty acres the extent of flax should not exceed one-tenth; and as the farm increases in size,

the proportion of flax may be extended, but not greatly in excess of this ratio.

After potatoes or old pasture, off which one white crop has been taken, a good flax crop may be grown. Flax too frequently follows wheat or oats grown after a green crop the previous year, a practice which only answers when condition is kept up by extra manuring.

Little need be said on the too frequent repetition of flax on the same ground, and for this reason, if the proportion pointed out is adhered to a sufficient interval will of necessity elapse; it should not be repeated more than once in seven years.

In the south of Ireland, flax is frequently put in lea land, and although heavy crops are often produced, the practice is objectionable; one reason is the difficulty of bringing such land into a proper state of tillage; another is the danger of cutworm, which attacks not only flax, but corn sown in lea land, and is often a source of much disappointment to the farmer. In flax-culture sufficient importance has not been attached to a judicious rotation; and want of attention in this respect has been in a great degree the cause of a diminution in the yield per acre. Flax has also become too frequently a stolen or extra crop, without a compensating quantity of manure being given to the land. An examination of the following rotations will illustrate what is meant more clearly. When no flax is grown, the usual four-course rotation is pretty generally adopted, viz.:

Potatoes and turnips,
Wheat laid down in
Clover and Grass,
Oats.

When flax, however, is grown, the rotation has too often become one of five courses, viz.:

Potatoes and Turnips,
Wheat,
Flax laid down in
Clover and Grass,
Oats,

which is objectionable, unless additional manure is given to keep up the condition of the land; too frequently the manure is curtailed instead of being increased, flax only producing money, which is not usually spent on the land.

The system that will maintain the land in a fertile condition is to adhere to what is commonly called the four-course rotation, in which flax would be included; but instead of putting all the land in wheat that had been in green crop the preceding year, it

should be divided, say two-fifths in flax and three-fifths in wheat, and by examining the following rotation, it will be seen that flax will not be repeated in the same land till after a lapse of nine years. When turnips and potatoes are both grown, it will also be observed that by *shifting* the side of the field flax will *never* follow turnips; flax following turnips is considered *very objectionable.*

Year.	Crops.		
1	Turnips.	Potatoes.	
2	Wheat or Oats.	Flax.	1st Year.
3	Clover and Grass.		2nd "
4	Oats.		3rd "
1	Potatoes.	Turnips.	4th "
2	Flax.	Wheat or Oats.	5th "
3	Clover and Grass.		6th "
4	Oats.		7th "
1	Turnips.	Potatoes.	8th "
2	Wheat or Oats.	Flax.	9th "

The above rotation has been prolonged to show flax returning to the same land in the ninth year. The two-fifths allotted to flax would be in the ratio of 10 per cent. as a proper proportion of a farm to be appropriated to flax. What really would reinvigorate the growth of this valuable crop would be to decrease the acreage allotted to wheat, and substitute flax.

These observations apply to the north of Ireland, and of course they would require to be modified to suit various kinds of land; in fact, no absolute rule can be laid down, the farmer must exercise his judgment. It is not to be supposed that the rotation mentioned is to be adopted without intermission;

any one acquainted with farming operations must be aware that ground cropped for a succession of years must have rest. These rotations are merely introduced to exemplify the judicious repetition of crops in ground under cultivation, assuming that a portion of the farm is undergoing the necessary renovation produced by its remaining in pasture for some years.

Stubble land intended for flax should be ploughed deep in the autumn ; if light, allow it to remain till seed-time ; medium land may require a second ploughing, which should be done not less than two months before sowing. Heavy land will, without doubt, require the second ploughing, and perhaps grubbing, to bring it into a proper state. The second ploughing must not be deep, about three or four inches. When flax is intended to be sown in potato ground, it must only receive one shallow ploughing, say three to four inches deep, and if the soil is light, this should not be done till a month or six weeks previous to sowing ; but if heavy, it would be desirable to have it ploughed earlier, so that the land may be exposed to the pulverising influence of frost. When seed-time arrives, should weeds, such as docks, sitfast, couch-grass, &c., appear, they should be removed, *previous to harrowing*, by men with grapes or spades, and children to gather. When this is done, harrow fine ; if in ridges, up and down *only ;* if flat, cross-harrow also : the reason for not cross-harrowing ground in ridges is, that it draws mould into the furrows, and leaves too loose a bed for the seed in the furrows and on the brows. Flax likes a firm bed. When the land is drained, or naturally dry, it would be better to put it in flat, which will make the crop more even in length. It is a great matter to have flax as uniform in length as possible : when there are furrows in the field, it will grow shorter in the furrows and on the brows, which should be avoided.

The extent of pulverising depends on the nature of the soil ; on light and medium land, excessive pulverising does injury. If it has received a deep ploughing in the autumn, and, when necessary, a shallow winter ploughing in addition, a moderate harrowing will leave a sufficient quantity of fine surface-mould to give a good bed for the seed. Pulverise such soils to any great depth, and the chance of a good crop is doubtful, unless in an unusually wet season. Heavy land, on the contrary, will bear any degree of pulverising.

After every harrowing, pick the land perfectly clean of weeds, remove any loose stones that are large (small stones will do no harm). Previous to sowing, roll once. After rolling, some give a single stroke of a seed-harrow before sowing, but others recommend sowing on the rolled surface. A dry calm day must be chosen for putting in the seed. Flat ground should

be tracked out into lands to guide the sower. This is not to be done with a plough, but the ground should be merely measured and traced with a man's foot, or poles put up as guides. As to the time for sowing, much depends on the situation. Near the sea-coast it will be safe to sow early; inland, too early sowing is hazardous, for fear of the late spring frosts, which do material damage, frequently causing injury to the tender plant, and thereby making it branch—one of the greatest misfortunes that can befall the crop. The object of an early sowing is to have an early pulling, but this is not always attained, as so much depends on the weather during the summer. Late sowing will often produce a heavy crop. Notwithstanding the dread of late spring frost, it would be, however, advisable to have sowing completed before the last week in April, so as to have the flax abraird by the 1st of May.

The kind of seed depends on the ground. On heavy soil, or after green crop, Dutch seed would be the most suitable; on light or medium soil, Riga seed will answer best; as to the quantity of seed much depends on the kind sown, quality of seed, and the description of fibre wanted. Dutch seed produces a finer fibre than Riga, but the class is also affected by the quantity sown; thickly-sown seed produces a finer fibre than that sown thin. With good seed, about 2 bushels will sow a statute acre, $2\frac{1}{2}$ bushels a Cunningham acre, and $3\frac{1}{4}$ bushels an Irish acre; but a man who understands sowing (and no other should be employed) need not be confined to a specific quantity; experience will have taught him how properly to distribute the seed, having ascertained the wishes of the grower as to the nature of the flax he is desirous to produce. Riga seed should be cleaned with a flax sieve previous to sowing, to get rid of the weed-seeds: this will save expense and labour when weeding-time comes round. Dutch seed, being much better cleaned, will seldom require this operation. Flax sieves of perforated zinc are made expressly for this purpose, and can be purchased for 2*s.* 6*d.* each. After sowing, harrow-in with a seed-harrow; two strokes will usually do.

Ground intended to be laid down in clover and perennial rye-grass should be sown immediately after the flax, and before it is harrowed-in. No Italian rye-grass should be sown with flax, as its vigorous growth causes it to injure the lower portion of the reed of the flax, particularly in wet seasons. If Italian is wanted, let it be sown on the surface after pulling, choosing a wet day. If dry, roll at once across the field, not up and down; on potato land, extra rolling will be required. The best chance for a good crop of flax is rain coming immediately after sowing is completed, it makes a strong and even braird; but if any weak

spots appear, a dressing of soot or of a stimulating artificial manure will much improve it, and should be applied in wet weather. The use of artificial manure in the case of flax is objectionable, unless to invigorate a crop, the growth of which is retarded by untoward weather. Farmers should always select land calculated to produce a crop under average circumstances without the aid of stimulating manures.

Weeding should commence as soon as the flax is abraird and the weeds begin to appear, and should continue at intervals till the crop has attained a height of 4 to 7 inches, pulling the seed-weeds and cutting the larger ones that have strong roots. The weeders should have no shoes on, and they must be most careful to tread on the flax as gently as possible, putting down the foot flat, and not twisting it while on the ground; the crop will quickly recover the effects of careful weeding. After this operation, nothing remains to be done until the crop is ready for pulling. When the blossoms fall and the bolls are formed, the flax has attained its height. If the weather is dry, and has been so for some time, do not on any account attempt to pull the weeds, as that would injure the crop materially by loosening the ground about the root of the tender plant, and cause it to yellow and become sickly, from which it will seldom recover. Better allow the crop to remain unweeded—in fact, never weed unless the ground is damp.

When ready for pulling, the stalk next the ground will become of a pale yellow, the leaves will fall off 8 to 10 inches from the ground, and the *top* seed-bolls will also assume a slight brownish hue. Judgment is required: taken too young will make a tender fibre, and loss will occur in scutching; allowed to get too ripe will make a dry coarse flax. Experienced hands should, if possible, be secured for pulling: children will not do. The flax is caught a short way below the bolls, and by a dexterous jerk of the arm removed from the soil. It is then laid down in handfuls as pulled, of a size that can be conveniently grasped, and crossed, so as not to entangle, the butt- or root-ends to be kept as even as possible, and then tied in beets (Fig. No. 1).

Fig. 1.—*A beet of Flax.*

If the crop is to be rippled, it should then be carried by children to the ripplers. The rippling-comb need not be described, as it can be bought very suitable for the purpose; but *round* iron for the teeth is much preferable to square—the latter is liable to tear the flax. It should be bolted to

a plank, and securely lashed to the body of a cart taken off the wheels. When full, the cart is to be lifted, and the wheels put on, and the bolls removed to where they can be dried; or the rippling-comb may be fixed on a frame, if more convenient, and the bolls allowed to fall on the ground or on a sheet. In this operation the flax should be handled with care. Three or four strokes through the comb will be sufficient. Each handful of flax must be held *very* tight with both hands, and slightly opened like a fan. The extreme ends should only enter the comb at the first stroke, gradually increasing at each succeeding stroke as far as the bolls extend. As rippled, children carry it to be tied in beets, which ought to be loose in the band and small in size. Rushes make the best band, but there is little or no waste in using short flax to tie with. It is then ready to cart to the dam. The bolls in the green state should be at once removed and spread over lofts, turned frequently, and when partially dried, taken to a corn-mill and finished on the kiln moderately heated. If the crop is very uneven in length, it is desirable to make two pullings, keeping the long and short separate, and steeping each apart. The dams should be made long before they are required, and dug out of clay if possible. Moderate-sized dams are recommended in preference to large—9 to 12 feet broad, and 4 feet deep will answer, but the dimensions will vary according to the situation; 4 feet deep should not, however, be exceeded. Choose a sheltered situation, with an aspect exposed to the sun. Make them sound, so as to retain the water, and bear in mind that flax-water will leak through what would retain clean water. It would be difficult to give the capacity of a dam which would contain the produce of an acre of green flax, so much depends on the crop; a dam, however, about 50 feet long, 9 feet broad, and 4 feet deep, should contain the produce of a statute acre of an average crop.

If the dams are so situated as to allow the water to be run off, fix a pipe in the bottom or side for this purpose; never use the same water a second time to steep flax in. Soft water is by far the best; however, exposure to the atmosphere will considerably improve water with some degree of hardness. Water impregnated with iron, unless in such quantities as to cause iron-rust (this is seldom to be dreaded), should not be rejected, *if no better is to be had*. The presence of iron will not make it hard, the only effect it has is to discolour the flax to some extent, and of course from this cause lessen its value. When a farmer has soil that promises to give a good yield, he should not be discouraged from sowing flax because he has no other than water with a tinge of iron in it to steep in. Bog-holes used as steeping-dams are not objectionable, but should be of old formation. What

must be avoided is water largely impregnated with lime, and if no other can be had, a farmer should not grow flax. There is an easy test (call it chemical, if you will), accessible to every one, any water in which soap will not curdle is sufficiently soft to steep flax in. As regards this important matter of water, observation ought to be the guide to a great extent. If new dams are required, they should be dug out during the winter, old dams should also at this season be repaired when necessary, and generally filled from surface-drainage and kept full till steeping time. If this method were generally practised, there would be fewer complaints of want of water when steeping time arrived.

The next operation calls for special attention, as it is by far the most important and delicate process the crop undergoes, and on which the success of it as to quality depends, viz., retting or watering. After the beets have been tied in the manner described, they are carted to the dam. What is pulled each day should be put into the dam the same evening if possible, but never mix one day's pulling with what has been pulled the day previous. Begin at one end of the dam, and place the beets in rows close together, side by side, with the root-end down. When one row is completed, commence a second, placing the top of the beet about the strap of the first row, and so on, row after row, till the dam is full. A layer may be put on the top, laying the beets flat. The next thing to be done is to cover the flax with rag-weeds, rushes, or straw. If boards can be had, it is very desirable to place them on the covering before putting on stones, or sods with the grassy side down, to sink the flax below the surface of the water. The above is presuming there is already sufficient water in the dam; but if it could be so arranged as to have a stock dam situated above the steeping-dams, it would be more advantageous to put the flax in dry, and, when stoned, run the water in.

The sooner fermentation commences, the better. If the weather has been and is warm, it will set in immediately, and will cause the flax to rise and come above the water. It must be well trampled down, and more stones put on. When the fermentation subsides, it will sink in the dam; it will then be necessary to remove some of the stones to let it rise to the heat, but never allow it to get above the surface. After a few days the flax must be examined, and then is the time when judgment is requisite to decide when it is sufficiently watered. Take a beet or two out of different parts of the dam, open and examine. If glit appears in the middle of the beet, and it feels soft when grasped in the hand, it is an indication that great watchfulness is necessary. Take three or four reeds, which will be found covered with a greenish slimy substance, and if this can be

removed from the surface by delicately passing it through the finger and thumb, it is an unmistakable indication that it is in a condition to leave the dam; also bend them gently over the forefinger, and should the woody part freely separate from the fibre and start up, it is time to throw it out. The reed must be examined throughout its length, as it will be found softer at the root-end; but if it yields to this test in the middle, it may be safely considered watered. Try both tests, and examine both coarse and fine reeds. The coarse will "water" before the fine, so an average of condition must be taken. The Dutch test is by taking a reed and holding 10 inches of the middle of it, and twisting with each hand in the reverse direction. If the fibre separates freely from the core, it is considered watered. This is by far the most critical operation in flax manipulation. Flax is most frequently under-watered, the farmer calculating on the grassing finishing the operation. Water well, and leave little more than drying necessary on the grass; that is, do not remove the flax from the dam till the fibre separates easily from the core or woody matter. When you commence to examine, it must be done daily, and as it approaches being finished, it should be looked at twice each day. When you are satisfied that the flax is retted, take the stones off, and throw it out on the bank; allow it to drain for an hour or two, and then cart to the spread-ground. A prevalent but very mistaken idea exists that "hard" flax will yield better at the mill. The reverse is the case. Properly watered flax will require less scutching; but the very heavy scutching which is necessary to clean under-watered flax, reduces to tow much of what otherwise would remain flax.

Grassing is the next operation. Grazing or stunted pasture is best for this purpose. Any tall weeds or grass should be cut down with a scythe before spreading. Distribute the beets at convenient distances for the spreaders, who should shake it out thin and evenly in rows across the field, letting the top of each row lap the root-end of the preceding one about two inches, which is a great protection if high winds happen. When on the grass, some object to overlap, as the flax has a tendency to entangle in the operation of lifting. Flax is sometimes turned while on the grass, which, no doubt, is an advantage, but a dangerous operation at the season when flax is spread in Ireland, as it loosens it on the grass, and the wind has more power over it; however, if it is to be turned, it must not be overlapped.

An inexperienced hand will feel alarmed on examining his flax the day after it is spread to find it quite "tight," and, without much rubbing, the fibre most unwilling to part from the woody core; but if it has been properly watered, a day or two will remove all apprehension; it will begin to "bow"—that is,

the fibre contracting, leaves the core and forms a string. When this takes place, and a slight rubbing causes the woody core to break and fly off, leaving the fibre entirely, it is ready to lift. Never take flax off the spread unless on a dry day, nor if the dew is on it. In lifting, great care must be taken to keep the butts or root-ends very even. Lay it down in bundles of sufficient size to make small beets, then tie moderately firm and stook for a few days if the weather is settled; but if doubtful, carry it to a loft or stack, it being now ready for the scutch-mill.

The foregoing directions as to these very nice operations assume that the weather has been such as is calculated to produce the most favourable results. If the steeping process is approaching its final stage, and the weather should appear unsettled, with a falling barometer, the flax should be taken out of the dam before it is quite ready; it would in this condition (being what is termed "somewhat hard") be better able to stand without injury unfavourable weather on the grass. On the other hand, if the flax had been sufficiently watered before leaving the dam and got thoroughly dry on the grass, and there appeared an indication of rain, or, as occasionally occurs, that dry weather would set in with a scorching sun, it should be lifted and put in stacks, where in a few months it will attain that condition which a longer time on the grass under favourable circumstances would have effected: indeed, it is advisable not to take flax immediately to the mill; stacking will improve it, and make it in better condition for scutching. If, as frequently happens, a continuance of rain occurs while flax is on the grass, and before it can be got properly dried, it will do it much injury, causing it to mildew, more especially when the grass begins to grow up through it. In this case it is recommended to be lifted in large handfuls, and set up in the shape of a hollow cone (Fig. 2). Lifting flax when dry off the grass is done by gathering the root-ends in the hand; but lifting to be put in these cones must be done by the boll ends, and, when formed into the cone, the straws should be slightly twisted at the top so as to make the cone stand, and, to some extent, prevent wind blowing it down; but, from the dread of high winds, caution must be used in adopting this practice.

Fig. 2.

A few words are necessary regarding seed, the supply of which is principally foreign. In this climate home production would be too precarious to de-

pend on, and another consideration is that, to treat flax so as to save seed suitable for sowing reduces the quality of the fibre. The saving of seed for sowing, however, is not sufficiently attended to in Ireland, and it would be desirable that growers of flax should reserve a small portion of each year's crop for seed—of course, assuming that the crop is grown from Riga seed. The portion set apart for seed production should be sown rather thinner than that from which no sowing-seed is intended to be taken, and it should be allowed to ripen on the foot. Poor stunted spots often occur in flax-fields which might be judiciously left to mature, and save the seed therefrom. Seed must be selected by its appearance, choosing it of a bright colour and plump, and as free as possible from imperfect pickles; but even with all these characteristics the farmer may not procure a really good article; the surest method of obtaining genuine seed is to purchase a known brand from a reliable importer.

It is stated that in Belgium seed two years old is preferred, but no seed beyond one year old should be sown without testing its vegetating power.

It may be observed that little has been said about the time these operations require; for this reason, that so much depends on the weather and other conditions where *observation can be the only guide.* For example, if the weather is warm both day and night during the period of steeping, it will take far less time than under reverse circumstances. Flax cannot be watered to advantage when the nights become chilly. Every farmer should have a barometer, and regulate all his outdoor operations according to its indications. It will prove a faithful friend, and save not only money but a vast amount of anxiety.

The manurial value of the water in which flax has been steeped has been overrated, and it is very doubtful if it is worth the cost of pumping and distributing with carts over the land. Certainly it is not practicable for the small farmer.

The operation of drying flax in the field for holding over till the following summer before being retted is seldom practised in Ireland unless from necessity, owing to lack of water or other circumstances; and experience has shown that such a system in a climate of so uncertain a character as exists in Ireland, would be attended with doubtful results. The flax produced is usually striped and discoloured, and the quality otherwise injured, more especially when the seed has been matured for sowing purposes. However, this method should not be discouraged, as, in the event of its being successfully carried out, it has advantages to recommend it. The Belgium mode, so far as the manipulation is concerned, is the best—of course steeping would be done in

dams, as at present, as the system adopted at Courtrai would not be practicable in Ireland.

In the casualty of firing, to which the flax-crop is more or less subject as it approaches maturity, particularly the produce from Dutch seed, the stalk becomes spotted with blotches of a dark brown colour, which have the appearance of what would be produced by fire—hence the term. There is no remedy; but when these spots or blotches appear, the crop must be carefully watched, and if the firing makes rapid progress, the only alternative is to pull at once, even if not ready, and steep immediately.

It would be impossible to convey how the scutching operation should be done to the best advantage. Experienced scutchers, with attention, will turn out good flax, provided it has been properly handled by the grower. If care has been taken in the several stages to keep the flax even, it will facilitate the scutching; that is, when pulled, when tied in beets after being rippled, when spread, when lifted off the grass, and when finally tied in beets for the mill it will go evenly into the rollers, and the streakers, unless very careless, can give it in nice order to the scutchers, who will be enabled to do their work with much less loss than would arise if it arrived at the mill in slovenly made beets. If more uniformity in the condition of the straw as it comes from the farmers could be attained, improved machinery of a lighter description than that at present in use could be employed; however, the preliminary operation of breaking is most important, and very efficient machines have been constructed, but owing to the comparatively small amount of straw that can be manipulated per day, they have not come into general use. The more perfect the breaking is, the less scutching is necessary, and therefore it diminishes the waste so general now, by lessening the quantity of tow produced.

In Ireland the mode of cleaning by hand-scutching might be more extensively practised, and owing to the yield obtained being so much larger than by mill-scutching, this method would probably remunerate the farmers better. The present pernicious practice of fire-drying, however, is very detrimental to the quality of the flax, by robbing it of its oily nature, and producing a dry harsh fibre. More attention should be given to breaking the flax properly before being scutched. In Holland this is principally done by ordinary rollers driven by steam-power; but when this is not available, a very efficient hand-breaker, extensively used in Belgium, might be employed. It is simple in construction, and inexpensive (with improved facilities of breaking, "fire-drying" might be discontinued).

Further particulars might be given regarding the mode of tilling the land, &c., but such details would be only adapted to a treatise on general agriculture; and it is inferred that any farmer commencing to grow flax would have such a knowledge of the agricultural department as would enable him to carry out the special methods alluded to in the foregoing pages.

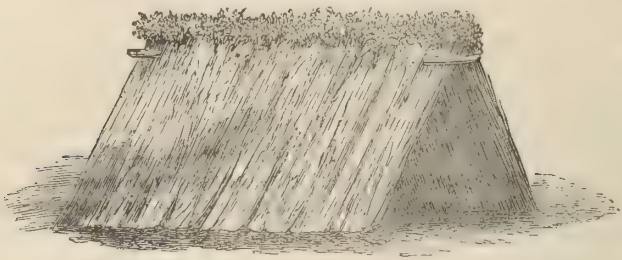
With regard to the cost of culture and preparation of flax, it would be difficult to give a definite statement, as there are so many contingencies to take into account, such as rent of land, cost of labour in different localities, the variable price of seed, &c.; but the minimum cost of growing the crop and preparing the fibre for market could not be under 10*l.* per statute acre. The yield per acre of fibre is the chief element upon which the paying of the crop depends, and is most fluctuating, being, like all other crops, dependent upon good culture and season; but high-class farmers usually obtain such a produce as makes this crop remunerative beyond the average of other products of the soil. The only country from which a reliable average could be obtained is Ireland, and the average yield in this country is so low, that to found any calculation upon it would mislead.

Before entering into the various artificial modes of flax preparation, which have been so frequently brought before the public, a few observations relating to the manner in which the cultivation of flax and its preparation are prosecuted on the Continent may be of interest.

In Belgium agricultural pursuits are carried on with a care and attention not known in any other European country, to which may be attributed that success in husbandry for which the Belgian farmer has acquired a world-wide reputation. Flax forms a very important crop in that country, and a fibre is produced which, for excellence of quality, is not to be found elsewhere. The finest and strongest flax is produced on loamy land, but selection of soil is considered subordinate to good tillage. Land intended to be sown in flax the succeeding year is ploughed in October and November out of corn stubble after a root-crop. Some time before sowing, which usually takes place from the 20th of February till the end of March, the land is dressed with powdered colza-cake, and watered with liquid manure. The quantity of seed sown per acre is greater than in Ireland, being 7 bushels to the hectare, or 2½ bushels per statute acre. When the crop is abraird, if considered too thick it is thinned by weeding out some of the plants. Great attention is given to the removal of all weeds, and as soon as they appear they are pulled out. During the early part of its growth the flax-crop is nourished by the application of liquid manure, which consists of house-sewage, preserved in towns, and sold to

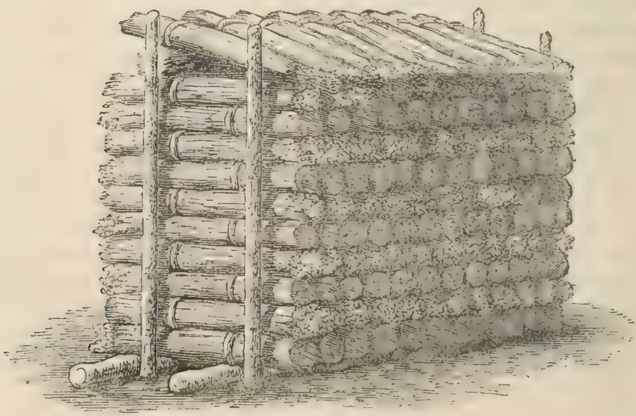
the peasants, who convey it to the country in barrels, where it is stored in brick tanks constructed for the purpose. Stimulating artificial manures are occasionally used, but it is considered injurious to the quality of the fibre to apply manures of this description to flax. When the crop has sufficiently matured, it is pulled with extreme care. That from which the finest quality is obtained is not allowed to remain till the seed has matured, so as to be fit for sowing purposes. When the flax is removed from the soil it is placed in stooks (Fig. 3),

Fig. 3.—*A Belgian Stook of Flax.*



without being tied in beets or sheaves, and remains till dry enough to be tied in beets, which are built in the field, in what are called hedges (Fig. 4), where it remains till it is sufficiently

Fig. 4.—*A Belgian Hedge of Flax.*



dry to be stacked or stored in barns, to be retted the following summer. The foregoing observations regarding the handling of the flax-straw after being pulled apply to the neighbourhood of Courtrai, which is specially famed for the superior quality of its flax, where the retting process is carried on in a manner peculiar to the district, in the river Lys. The excellence of the

fibre produced arises from properties which the water of this river possesses. It is practically a canal, and the current, which is very slow, is considered to contribute in producing the high quality of flax.

Before being retted the beets are placed on a floor, and the seed is threshed out with a mallet (Fig. 5) constructed for the purpose. Two beets are then tied together with straw-bands, the butts and tops being reversed: these are called bundles

Fig. 5.—*Mallet for threshing out Flax-seed.*

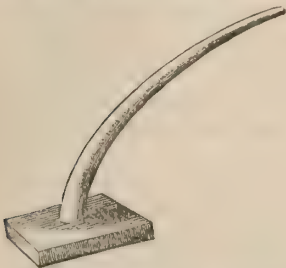
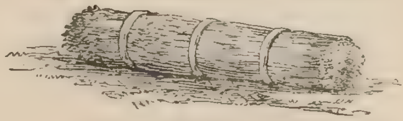


Fig. 6.—*A bundle of Flax-straw.*



(Fig. 6), and are placed in crates constructed of timber, which are lined with straw to prevent the flax coming in contact with the sides, and also to impede too forcible a current of water flowing through the flax. The bundles are packed in the crates in an upright position and covered with straw, and when filled, are floated into the river, and kept close to the bank by being tied to stakes. Boards are placed on the top of the straw, which are loaded with stones to sink the crates, so as to submerge the flax. After fermentation has set in, the retting process is allowed to reach a certain stage; the flax is then taken out and set up in hollow cones, and dried. It is again tied in bundles and repacked in the crates, and put back into the river, where it remains till the retting is considered finished, which is determined by delicate tests well understood by the Belgian farmer. When removed a second time from the crates, it is again placed in cones to dry; sometimes the flax is steeped three times. Previous to being scutched it is sorted by a competent manipulator. Each beet is opened, and the flax which is considered in a perfect condition is put aside as suitable for first-class fibre; what is over-watered, is kept apart to be separately scutched; and what is under-watered, is again put into the crates and submerged in the river till sufficiently softened.

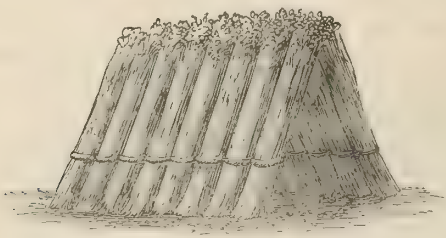
In what is called the blue districts the retting is performed in very much the same manner as in Ireland; more care, however, is exercised in procuring and preparing the water in the dams. In some instances, with the view to improve the colour,

branches of alder are placed in the ditches a considerable time before the steeping season and allowed to decompose. The water is stirred with poles, the alder branches removed, and the flax packed in, then covered with straw, and sods put on the top of all. When the retting is completed, the flax is spread on the grass, as in Ireland.

Until recently, scutching was all done in Belgium by hand; but now mill-scutching is getting more into use. Owing to the excellent condition of the flax the handles used for mill-scutching are very light, and produce a minimum amount of tow. After the flax is passed through the mill it is carefully hand-dressed and combed by experienced hands. The mills are kept free from dust by boxing in the handles, and carrying off the dust by a series of fans placed in a chamber and attached to a lying shaft, which is driven by the steam-engine that is in the mill for driving the other machinery.

The culture and preparation of flax in Holland is prosecuted in much the same manner as in the blue districts in Belgium. The operation of retting, however, is more concentrated, the flax being conveyed from where it is grown, in barges to the farmer's homestead. The saving of seed receives special attention, and the flax, as pulled, is tied in beets and stooked (Fig. 7)

Fig. 7.—*A Dutch stook of Flax.*



till dry enough to be stored in stacks or barns. The seed is removed by rippling combs before being retted, which is done in stagnant ditches, which have been previously cleaned out, and the mud so removed is used to cover the flax after being placed in the ditches. After being retted, the flax is spread upon the grass, if the weather is favourable; but if broken, it is dried in cones. The handling of the flax-crop receives as much care as in Belgium, and the scutching is principally done by hand-labour; and the preliminary operation of breaking is effected mainly by breakers moved by steam-power.

The country which produces the greatest amount of flax is Russia, the area annually devoted to this crop being estimated

at about 2,000,000 statute acres. The culture of the crop and the preparation of the fibre receive less care than in any other flax-producing country. The mode of tilling the land is very crude and primitive; weeding, on which so much importance is placed elsewhere, is never resorted to. A large quantity of seed is saved in this country. It is usually grown on poor soil, the seed of which is considered very much better for sowing purposes than that which has been produced on rich lands. Flax is sown thin in Russia, which partly accounts for the coarseness of the fibre. Were it sown thick, it would be more liable to be laid by the severe thunderstorms which frequently occur at the time it is in flower. It is unnecessary to go further into the details of flax manipulation in Russia; the scutching is done by hand, and forms an indoor occupation for the peasantry during the long and rigorous winter which prevails in that country.

The foregoing account only enters into the mode of treating flax by fermentation under natural circumstances: but hitherto the artificial methods which have been adopted to separate the fibre from the shove have not been attended, except in one instance which will be hereafter described, with favourable results. The application of chemical agents has also been unproductive of producing the desired effect. Schenck's process of retting flax at a high temperature by the introduction of steam into the water in the vats containing the flax attracted at one time considerable attention; but the fibre produced, although possessing many outward appearances of merit, was deficient in those qualities necessary to the spinner. A modification of Schenck's process consisted in introducing steam into closed chambers, in which the flax was placed. This process was known as Watts' patent, and also failed; the large establishments which were constructed for carrying out these operations are either in disuse, or have been converted to other purposes.

The end aimed at by these methods was to effect the separation of the flax-fibre from the shove in a more perfect manner and in a shorter time than by the natural process of fermentation, and thus do away with the present uncertain and precarious mode practised by each individual farmer, who is entirely dependent upon the weather during the steeping of his flax in the ordinary open-air dams, which are subject to all the vicissitudes of temperature that usually occur at the season of the year when the flax-crop arrives at maturity.

From past experience, any artificial method of treating flax is naturally viewed by those interested with disfavour and dis-

trust; but the large proportion of indifferently handled flax which is produced in many flax-growing countries should cause any practical and efficient artificial method to be a great advantage to those engaged in the industry which depends upon flax as the raw material.

Some years since the idea occurred to me that a system most likely to be successful would be one that would as closely as possible imitate the best results attained by the ordinary methods under the most favourable circumstances; that is, to ret the flax at a suitable temperature of a uniform and permanent character. Under Schenck's and Watts' process this desired condition was absent, as in dealing with steam at a considerable pressure the flax would be liable to the danger of overheating, so long as steam, as a heating medium, was introduced directly into the vats in which the flax was placed. The method adopted to ensure safety is to place the flax in vats contained in chambers heated by steam-pipes, the water being introduced into the vats at the required temperature, and this temperature maintained by heating the surrounding atmosphere of the chamber—in other words, simply by creating an artificial climate. By this arrangement it was considered that uniformity of temperature of any degree could be attained, as the vat containing the flax would be slow in sympathising with the fluctuations which might accidentally occur in the temperature of the chamber.

For the purpose of testing this theory, a miniature rettory was constructed, and fitted up with the necessary appliances. The chamber in which the vat was situated was 14 feet long by 10 feet wide and 8 feet high; the vat was of a capacity sufficient to contain 150 lbs. to 160 lbs. of flax-straw in a dry condition. The chamber was heated by pipes supplied with steam; the water available was suitable, having about 7° of hardness; it was used in the vat for retting and for washing the flax after it had been retted. The flax-straw was placed in the vat in a perpendicular position, being tied in beets loosely, the butts and tops being reversed in each row. The beets were confined in the vat with boards fastened down with iron bars. The steam which supplied the pipes for heating the chamber was under control by means of a stop-cock. These arrangements in practice proved very efficacious, and the facility of maintaining a uniform temperature in the vat was accomplished. When the temperature of the chamber rose very much beyond that of the vat, the latter, for a considerable time, was but slightly affected, owing to the tardiness of the temperature of the vat in responding to that of the air in the chamber. On the other hand, when the temperature of the chamber fell considerably below that of the vat, the latter

was also very slightly influenced. To exemplify this more clearly, an excess of steam was accidently admitted, and the temperature of the chamber rose from 80° to 99°, and remained at this point for some time, but the vat did not go beyond 80°, and the steam was then cut off. On another occasion the steam was cut off entirely, and continued so during twenty-four hours, and the temperature of the chamber fell from 75° to 63° during the night, whereas the vat only fell from 70° to 69° during the same time. These particulars are dwelt upon at length, as on this fact depends the important feature of the system, viz., the protection of the flax-straw during the retting process from undue heat, which would endanger the quality of the fibre, or an undue chill, which would check the fermentation. The fermentation is in full vigour in twenty-four hours after the commencement of the process, and continues uniformly for some days, when it gradually subsides as the operation approaches completion.

The superiority claimed for this method of retting flax over what is known as the "hot-water steeping" is uniformity of temperature, and the experiments made demonstrate that an absolute control can be exercised over the means adopted to produce the artificial climate in the chamber in which the vat containing the flax is situated. One of Six's combined maximum and minimum thermometers was placed in the chamber, and one immersed in the vat, so that the relative temperatures could at any time be observed. The temperature at which the experiments were made varied from 72° to 80°, and the retting process occupied from six to ten days. It may be observed, however, that hastening the process by means of raising the temperature has the tendency of reducing the strength of the fibre.

The flax was washed after leaving the vat, and part of it passed through iron rollers previous to being dried. To detail all the particulars would occupy too much space, but these experiments indicated that there is much yet to be ascertained before the handling of flax will have obtained that degree of perfection which it should possess when the retting has been reduced to a manufacturing process. During the prosecution of some of these experiments, the ground was covered with snow and the temperature outside below freezing-point. The results under such circumstances were equally as satisfactory as when the surrounding atmosphere was of a more genial warmth; in fact, this method of retting is an accomplished success, and the flax produced has proved to be of superior quality and eminently suitable for spinning purposes. Doubts were expressed as to

the yarn boiling satisfactorily, and some were sceptical that the linen produced from flax so treated would bleach satisfactorily. These contingencies have, however, in practice disappeared. The flax was spun to fine numbers; the yarn was boiled, then converted into linen which bleached to perfection. The chief advantages resulting from a successful artificial mode of retting flax being brought into operation would be a concentration of skill, and the process being pursued continuously during the entire year.

The experiments made were numerous and satisfactory, but percentage results were not noted in every instance. The following is an average of the yields of four experiments:—

Average yield of retted Straw from dried Straw ..	76·29	per cent.
„ Fibre „ retted „ ..	23·86	„
„ Fibre „ dried „ ..	18·18	„
Average time occupied in retting, about 8 days.		
„ Maximum temperature	75·01°	
„ Minimum „	72·16°	

In the first experiments the temperature of the chamber and that of the vat varied considerably, as, the operation being new, complete command was not at first obtained over the heating medium; but in subsequent experiments almost absolute uniformity between the heat of the chamber and that of the vat was produced; sometimes for days it would not vary more than a degree or two.

There are obstacles in the way of adopting this system in a variable climate, and one is the uncertainty of drying the flax in the field after being pulled, and preserving a uniform colour; but this could only be tested practically.

The theory of the process has been verified in every particular, but the question yet remains to be solved, would it as an enterprise prove a success?

Flax is cultivated in almost every country in the world; in some instances mainly for its seed, which is crushed to make oil, and the cake is used for feeding cattle. What is grown in Europe is principally for fibre, the linen industry being an important occupation; and although now much more extensively manufactured by machinery, it still forms a prominent feature among the rural population in Continental countries. In Ireland, however, which is the chief seat of the linen trade, the spinning-wheel has entirely disappeared, and the spinning of yarns is done in large mills situated principally in, or in the neighbourhood of, towns. The following statement is inserted to give some idea of the production of flax in European countries:—

Austria	=	218,042 Statute Acres, producing		45,162	tons of Flax.
Belgium	=	140,901	,, ,,	29,580	,,
Denmark	=	6,292	,, ,,	787	,,
Egypt	=	15,000	,, ,,	1,875	,,
France	=	162,099	,, ,,	36,969	,,
Germany	=	329,362	,, ,,	57,432	,,
Greece	=	957	,, ,,	119	,,
Great Britain	=	8,985	,, ,,	1,398	,,
Hungary	=	27,048	,, ,,	5,301	,,
Holland	=	44,114	,, ,,	7,386	,,
Italy	=	200,356	,, ,,	22,953	,,
Ireland	=	157,534	,, ,,	24,508	,,
Russia	=	2,000,000	,, ,,	250,000	,,
Sweden	=	33,639	,, ,,	4,205	,,
Europe	=	3,344,329		487,675	

The above list does not include the flax which is grown in British India and the United States of America, where very little fibre is saved, the seed being used for the production of oil. The area under the crop in the United States is said to be not under 400,000 statute acres.

In order to show that there is room for a more extensive production of home-grown flax, the following figures are inserted, giving the supply which was available for the requirements of the linen trade in the United Kingdom in 1879 and 1880; and it may be mentioned that the average imports of the last ten years were 98,642 tons:—

	1879.	1880.
	Tons.	Tons.
Foreign Imports	84,755	94,812
Irish Production	19,611	24,508
British ,, ...	1,081	1,398
	105,447	120,718
Deduct Exports..	3,278	2,979
Net Supply	102,169	117,739

It may be observed that the preponderance of the supply is derived from abroad, a portion of which under any circumstances would require to be maintained, as foreign flax of a class which cannot be produced at home is essential for the production of a description of yarns spun by some spinners; but a much more increased supply of such flax as is produced in Ireland would find a ready market.

The fabrics of which flax forms the basis are, as before mentioned, a staple industry in Ireland, and the manufacture of the finer classes of goods is mainly confined to the province of

Ulster. For texture and excellence of finish these fabrics are unsurpassed, and for durability they will compare favourably with any analogous manufacture. It would be irrelevant to enter into details regarding the merits of the many useful and artistic materials which are manufactured from the product of the flax plant, and which only require to enter more extensively into general use to be fully appreciated.

XXVI.—*Flax-Farming in the Netherlands.* By H. M. Jenkins, F.G.S., Secretary of the Society, and Editor of the Journal.

[Reprinted from the 'Report on the Agriculture of the Netherlands to the Royal Commission on Agriculture.']

The most important seat of this industry is the island of Ijsselmonde, immediately opposite Rotterdam, from which it is divided only by the river Maas. Formerly this island was also the district in which flax was principally grown, but for this purpose it has long since been exhausted, or, as the expression goes, *flaxed-out.* Like some other crops, flax cannot be profitably grown frequently on the same land for long together; and so the soil of Ijsselmonde has become obstinately flax-sick. Still it appears that the inhabitants of the island, having become acquainted with all the details of the cultivation of the plant, and the preparation of the fibre for the market, the industry still remains there, although the actual growth of the plant is removed to every other district of the Netherlands. Some of the so-called "flax-farmers" have farms of their own, either as proprietors or tenants, in the island of Ijsselmonde. These are cultivated in the ordinary manner, but a crop of flax is now rarely taken.

Flax-Growing.—For flax-growing the "farmer" either hires land for the purpose or he buys the crop at harvest-time. The former method appears to be most liked by both parties, and the natives of Ijsselmonde may be seen at the proper season weeding the flax in every part of the Netherlands, even to the extreme north of Groningen. The "flax-farmer" pays from 8*l.* to 11*l.* per acre for the land duly prepared for sowing. An oat stubble is preferred, but a wheat stubble is also accepted, and a very fine tilth is absolutely necessary. The land must have been properly manured for the corn crop, but no manure is applied for the flax, except as presently stated. The "flax-farmer" sends his seed and has it drilled by machine, Riga seed being generally preferred. If the season is very backward, and it is thought neces-

sary to force on the plant so as to get it out of the way of the hopping beetle, which attacks it in its young state, a top-dressing of guano or nitrate of soda is applied. Such manures are found to increase the quantity of straw, but to injure its quality, and perhaps even to reduce the quantity of available fibre.

Weeding.—In the Netherlands care is taken to preserve the seed as well as the straw, therefore the crop is left to ripen. It is harvested as usual, being pulled up by the roots, and the seed-pods are then removed by hand. Between seed-time and harvest the flax crop requires incessant weeding, at any rate so long as the hand-picking of weeds can be continued without injury to the growing crop. Therefore the "flax-farmers" send to the districts where they have hired land a number of men, women, and children, who go from farm to farm to weed the flax. They are paid by the flax-farmer, generally about 1*s.* 8*d.* per day for the men, and women and children in proportion. They sleep in the barns or out-houses, on hay, straw, or whatever they can find for the purpose, and the "flax-farmer" does not seem to trouble his head about them. When they are not wanted for flax-weeding, during the summer, they frequently get odd jobs from the farmers of the district. In the autumn they return to Ijsselmonde and are employed in the various operations by which the flax-fibre is prepared for market.

Steeping or Retting.—The crop having been harvested, it is sent in barges to Ijsselmonde, where it is steeped in ditches. There are an infinity of details relating to this process, upon the success of which the quality of the fibre to a large extent depends. Possibly there may be something in the water of the Ijsselmonde ditches which accounts for the concentration of the industry in that island; but some growers in other districts say that water can be prepared to produce the same result. However, in Ijsselmonde they prefer what they call an "old ditch," that is to say, a ditch with an old bottom of mud; then the number and age of the willows growing on the sides of the ditches have to be taken into account, as the willow roots are supposed to have a great influence. The age of the mud is of importance, because the straw is covered with it during the soaking process. The soaking takes place during September, but no rules can be laid down with regard to it, as every field of flax and every ditch of water renders some variation necessary to produce the best result.

Drying.—The flax having been soaked, it is dried as completely as possible in the open air, and the drying is finished by artificial means. Under the old system a fire is made by

burning the "chaff" from previous scutchings, namely, the outside skin and the core of the straw, which are useless for any other purpose. This is burnt in a trough, and the flax-straw being placed in a layer just a safe distance above it, becomes practically dried. A more recent and less dangerous system is to place the straw on iron rods, about 2 feet above some large hot-air pipes, heated by an oven. After one or other of these processes, the sheaves are placed in a hot-air chamber, where the drying process is completed.

Scutching.—The next step is the scutching, and this must be divided into two parts; the first is a kind of crushing or breaking between fluted rollers, either by the old hand-machine, through which the straw is passed two or three times until the skin is sufficiently broken, or by a power-machine of more perfect construction. The latter is worked by a four-horse power horizontal donkey engine; and by means of an eccentric actuating a cog-wheel the straw is worked to and fro between the fluted rollers until it gradually finds its way out on the other side.

The second part of the scutching operation is generally performed by hand, but recently steam-power machinery has been devised and is already largely in use, for this purpose also. The process by hand may be thus described:—A bundle of flax prepared for the operation as already described is put into a notch in an upright board, so that by degrees more and more of the straw is made to hang over on the other side of the board. This overhanging portion is chopped at by the scutcher with a large, flat, and nearly square-bladed, walnut-wood chopper. He chops close to the notch in the upright board, and as he thinks that the straw is sufficiently decorticated, he pushes through an additional portion. Great skill is required to perform this operation properly, and without destroying a large quantity of fibre. Men and women, boys and girls, are all employed at it during the winter; they work by the piece and earn from 6*s.* 6*d.* to 10*s.* per week, but some few men can earn as much as 12*s.* per week.

Machinery for Scutching.—Scutching by machinery is on the same principle—rotating wheels, armed with projecting choppers of wood or iron, taking the place of the hand-worked chopper. The operation is precisely the same as that just described, but it requires even more care, both on the part of the operator and on that of the manager. Experience alone seems to be a safe guide as to the speed at which the wheels ought to rotate. In one case I was told that for some kinds of flax 60 revolutions per minute were sufficient, while other kinds required as many as 150 revolutions per minute. Although some of the samples of flax

scutched by machinery were obviously very much broken by the process, the "flax-farmers" who possessed machines were very well satisfied with the results which they had obtained. One man assured me that he had obtained 4 per cent. more weight of flax by this method than by hand-scutching, and an increased price of from 2*d.* to 4*d.* per stone (apparently about 6 lbs. English), while the cost of scutching was only 7½*d.* per stone by machinery against 10*d.* per stone by hand.

Ventilation of Work-sheds.—The great nuisance attending flax-scutching is the terrible quantity of irritating dust produced by the constant chopping off of little particles of the skin and core of the straw. This, however, has been practically overcome in the machine scutch-mills by boxing in the whole apparatus, fixing a hood over the upper half of each scutching-wheel, and placing an aspirator fan at the bottom of the chimney leading from the top of the machinery case. Provided that this fan has not to draw air from too great a distance, this arrangement answers admirably. Accordingly, in some establishments, where a large number of scutching-wheels are arranged in two parallel rows, there may be two of these dust-chimneys, each fitted with an aspirator, and completely ridding the air of the workshop of the straw-dust.

Acreage grown.—Nearly 50,000 acres of flax are grown in the Netherlands every year. In 1877 the weight of fibre exported was 11,377 tons; in 1878 it was only 7000 tons; but in 1879 it rose to 8744 tons. About one million stones are annually offered for sale on the Rotterdam market, so that not much more than a third is exported in the raw state. These figures are taken from the 'Report of the Netherlands Society for the Encouragement of Flax Industry for July 1880,' from which it also appears that the crop of this year, then standing in the field, was estimated to be worth from 12*l.* to 20*l.* per acre according to district, soil, and other circumstances. In the Netherlands, flax is generally grown on strong land, preferably rich alluvial soil, but it is also grown on sandy land and on reclaimed peat.

My warmest acknowledgments are due to Mr. C. E. Moll, the Secretary of the Netherlands Society just mentioned, for the kindness with which he conducted me over the island of Ijsselmonde, and explained the various processes to me.

XXVII.—*The Manufacture of Artificial Butter in the Netherlands.* By H. M. Jenkins, F.G.S., Secretary of the Society and Editor of the Journal.

[Reprinted from the 'Report on the Agriculture of the Netherlands' to the Royal Commission on Agriculture.]

This substance has been so much written and talked about during the last two or three years that it may be considered superfluous to refer to it in this report. As, however, the statements in the newspapers which have come under my observation have referred almost entirely to the American product, and do not give a correct idea of the Dutch "artificial butter" and its mode of manufacture, I propose to give a short account of the latter article.

Definition of Terms.—"Artificial butter" is the term I prefer to use, as being at once definite and easily understood. On the London market it is quoted as "Bosch," sometimes jocosely or ignorantly written "Bosh." The origin of this name is simply as follows:—The district round 's Hertogenbosch (Bois-le-Duc), commonly written 's Bosch, the capital of the province of North Brabant, for many years sent to the London market an inferior quality of Dutch butter. That particular brand has disappeared under the influence of the artificial butter, which is chiefly made in and about that region. In American journals, and in many English newspapers, one reads of oleomargarine as being apparently the same substance, whereas it bears the same relation to artificial butter that flour does to a plum-pudding. Butterine is another name that has been used, but, like the term oleomargarine, it has been applied indifferently to that substance, and to artificial butter properly so called.

Original Factory.—Holland is the chief seat of the manufacture of artificial butter, because no patent law exists in that country. Until recently there was but one factory, namely, that of Messrs. Jurgens, of Oss, a village about fifteen miles from 's Hertogenbosch; and for five years that firm kept the trade entirely in their own hands. Although at the present time there may exist fifty or sixty, or even more, factories, still Messrs. Jurgens retain the lead, and send to England from 70 to 90 tons of artificial butter per week. Two or three other firms follow, with an output of from 40 to 60 tons per week, and a host of smaller factories, and even farm-dairies, bring up the enormous total.

Consul-General Archibald's Report.—A Parliamentary Paper was published this year, entitled, 'Correspondence respecting the Manufacture of Oleomargarine in the United States,' in

which Mr. Consul-General Archibald thus states very clearly the main fact:—"The shipments of the outside manufacturers* are made to Hamburg, Bremen, and other German ports, and also to Rotterdam, but none, as I am informed, to the United Kingdom. In the case of the Commercial Manufacturing Company, their shipments are chiefly to Rotterdam, whence the oil is sent to a place called 'Oss,' and possibly to other towns in Holland, where it is mixed with a certain proportion of milk (to give it a butter flavour) and colouring ingredients to perfect its resemblance to butter, and is then churned and converted into butterine. It is then re-shipped to France and England, but chiefly to England, but under what designation I am unable to ascertain."

Mr. Archibald estimates the exportation of oleomargarine by the Commercial Manufacturing Company at 3,000,000 lbs. per annum, and that by "outside" manufacturers as nearly equal in quantity, so that at least 2500 tons are exported from America annually; and sooner or later most of it finds its way to Holland, to be made into artificial butter. At or near the abattoirs at Paris, Vienna, Munich, and probably other great centres of population, are also oleomargarine factories, and the produce of most of them go to swell the total of artificial butter which is made in Holland and exported "chiefly to England." The process of manufacture is by no means so simple as might be inferred from Mr. Archibald's statement, therefore it may be desirable to describe what I have seen, and to add what I have been told by the manufacturers, who expressed no wish whatever to conceal their processes from my investigation.

Oleomargarine Factory.—Oleomargarine is made in Paris at the factory, just outside the fortifications, belonging to the 'Société anonyme d'alimentation,' which has a paid-up capital of 24,000*l*. The internal fat of cattle killed at the abattoir at La Valette is bought either by private contract direct from the large butchers, but chiefly on the Bourse every month by contracts of a month's duration. The fat having been delivered at the factory, it is first chopped by hand into small pieces, then passed through hoppers between two rollers dentated with square-based pyramidal teeth. Thus brought into a sufficient state of subdivision, it is placed in steamers and heated to 122° Fahr. (50° Cent.); but on no account must the temperature be raised higher, or the quality of the oleomargarine will be deteriorated by its admixture with stearine—the true tallow. The fat melted at this temperature is run off into casks and left to cool and solidify naturally. When cold, the fat is passed on

* Viz., those outside the "Commercial Manufacturing Company."

to another department, where it is taken out of the casks in its more or less solid condition, and put in small quantities between coarse bagging and made up into flat parcels. A large number of these parcels are arranged in layers of four, six, or eight, according to circumstances, with a plate of sheet-iron between each. They are then submitted to hydraulic pressure, and the pure oleomargarine is expressed as a clear deep-yellow oil, the solid fat or stearine remaining behind. The "oleo," as it is generally called, is run into casks and left to solidify, after which it is exported to Holland at the rate of 250 tons per month, besides which a small quantity is retained by the Company for the manufacture of artificial butter, which they sell at their retail establishment in Paris under its proper name, in exquisitely neat "terrines," at 10*d.* to 1*s.* per demi-kilo (a little more than 1 lb.).

I have no reason to believe that oleomargarine is made differently, in principle, at Vienna, New York, or elsewhere; but, of course, the quality, as in the case of other products, depends partly upon the proper selection of the raw material and partly upon the care with which the various processes are carried out. At the Paris establishment the aim is to produce the purest material possible; and I am much indebted to Mons. Coenen, the manager of the Company, for not only allowing me to see the various processes, but also for explaining them to me with the most perfect frankness.

Manufacture of Artificial Butter.—From what I have already stated, it will be seen that oleomargarine, properly prepared, is neither more nor less than a kind of clarified dripping. Following it as thus made at Paris to its chief destination—the factory of Messrs. Jurgens at Oss—I will shortly describe how it is used in the preparation of artificial butter. Messrs. Jurgens receive from Paris something like 50 tons per week of the best quality "oleo;" they also purchase about 12 tons of the best Kampen butter, and 12,000 gallons of milk per week,* the latter being provided by the farmers in the district, who have found it more profitable to sell their milk to the factory than to continue making for exportation the inferior class of butter which was originally known as "Bosch." The "oleo" is melted at a temperature of about 120° Fahr., and is then mixed with a due proportion of milk and of butter. The mixture is then churned for a certain time, when a butter-like material comes, which is treated afterwards as butter would be on a large scale. The butter-milk and water are expressed, and the salt is incorporated by means of large fluted rollers, between which the artificial

* The quantities vary according to the season of the year.

butter passes, and is then delivered on to a long table on rollers, which carries it to the packers.

Use of real Butter.—The object of using the butter is said to be to give a grain to the imitated article; but I was curious to learn why the Kampen butter should be so strongly preferred by all the makers of artificial butter with whom I came in contact. A visit to the district of Kampen was sufficient to prove conclusively that the butter was made expressly for the manufacturers of the artificial article. Every farmer assumed that I was one of that numerous tribe; and in pointing out the excellencies of the staple product of their dairy they gave me the clue to the object of my inquiry. Butter made from sweet cream would be too delicate in flavour and in grain for the purpose of the maker of artificial butter, but an article produced by churning an unskimmed mixture of sour milk and cream has a sufficient strength of flavour and texture to enable a comparatively small quantity to go a very long way, and, in fact, to be very much improved to the palate by dilution with the comparatively tasteless oleomargarine. Certainly, the artificial butter at Messrs. Jurgens' warehouse, then being invoiced to London at 70*s.* per cwt., was a much better article to the taste than the Kampen butter used in its manufacture for which 100*s.* per cwt. had been given.

The artificial butter having been made as I have described, it is cooled by water reduced to a temperature of about 34° Fahr. by means of a Giffard's refrigerating machine on the compressed-air principle. The engine driving this machine has a power of 65 horses, and costs for coal and the wages of two engineers 2*l.* 10*s.* per day, which at the time I reckoned to be about 1*d.* for 10 gallons of water reduced to the above-named temperature.

Other Factories.—The factory just noticed is devoted entirely to the production of artificial butter, but the large majority of the establishments known as "Kunstboterfabriek" are modified cotton factories, linen factories, paper-mills, and, in fact, buildings which were erected and furnished for almost any kind of manufacture, but which, during the recent depression of trade, would have been condemned to partial or complete inactivity had not their owners hit upon the expedient of devoting surplus steam, surplus labour, and unemployed capital to the business of making artificial butter. A partner in such a factory at Helmond told me that their proper business was the making of cotton goods; but that of late years they had been compelled to restrict their output for want of a remunerative market, and as a substitute had made a very fair trade in artificial butter on the London market. They import their oleomargarine from America, and they purchase their milk from

farmers round about the town. Each farmer delivers at the factory twice a day as much milk as he likes to bring, and is paid at the rate of 7 cents per litre, or 6½*d.* per gallon; the average quantity delivered by each farmer is 30 litres, or 6½ gallons, and the greatest quantity is 45 litres, or 10 gallons. The butter of North Brabant, as already stated, is of inferior quality, and fetches only one guilder per kilo (about 9*d.* per lb.), therefore the farmers find it much more profitable to sell their milk at 6½*d.* per gallon. Usually about 10 per cent. of milk is used in the manufacture of artificial butter, and about one-half of its bulk remains incorporated with the oleomargarine and butter, so that the finished material contains about 16 per cent. of water. Some manufacturers use olive oil in place of a portion of oleomargarine, and others are trying to economise the milk by using a proportion of water with it; but the adoption of these expedients results in the production of an inferior article.

Effect on Wages.—This business enables the manufacturers to retain their best workmen by paying them about 2*s.* per day, the second-rate men earning about 1*s.* 9*d.* to 1*s.* 10*d.* They have the privilege of using as much buttermilk as they like, but it is generally too salt to be largely consumed. The low rate of wages may be to some extent explained by the fact that the people of North Brabant are Roman Catholics, and will not emigrate to the Protestant provinces of Holland where labour is dearer. To some extent, also, this accounts for the concentration of these factories in this province, instead of their being placed nearer the great ports and the great milk and butter-producing districts. In those districts, not only would wages be dearer, but milk could not be obtained at a price which would leave a sufficient margin of profit to the makers of artificial butter.

Milk Supply.—The smallest farmers supply still smaller makers of artificial butter, and as the quantity of milk sent by each is too minute to make its separate carriage to the factory profitable, a co-operative system of transport is resorted to. The cows are milked three times a day, and the produce of each milking is sent at once to the factory in a small cart just large enough to hold the cans and a boy, and drawn by a dog. A certain number of farmers join together either to pay for the carriage, or to take the milk of all for a week in rotation. These small people manage to get a somewhat higher price for their milk than the larger farmers, viz., 8 cents. per litre, or 7*d.* per gallon, but then they deliver three times per diem, and doubtless the cost of carriage of minute quantities is an item not to be overlooked.

Farm Factory.—There remains one other type of artificial butter factory to which it is desirable to draw attention, namely, the farm dairy. This I found on a large farm of reclaimed peat-land at Prince-Peel, near Mill, also in North Brabant. The farm itself is elsewhere described in this report (pp. 443–446), therefore I shall here confine myself to the question of artificial butter. Mr. Nering Bögel, the proprietor, uses his own milk and butter (produce of 100 cows) for this purpose, as he finds it pay better than sending his butter to England, or selling his milk to Messrs. Jurgens, at Oss, at the rate of $6\frac{1}{2}d.$ per gallon delivered to Mill station. The produce of the cows in milk is stated to be something enormous, for they are very highly fed, and Mr. Nering Bögel told me that his milk account with Messrs. Jurgens amounted to over 2000*l.* per annum. Butter for factory use is made from sour milk, experience having shown that it is more suitable for making artificial butter than that obtained by churning sweet cream, which is the method adopted by him for making butter for various household purposes. The oleomargarine is imported from New York, and the following are the proportions of the several ingredients used in the manufacture:—Oleomargarine 60 per cent., butter 10 per cent., milk and a little earth-nut oil (Arachis oil) 30 per cent. The earth-nut oil is considered to impart a good flavour, which olive oil does not.

Branding.—It is said that the Dutch Government insists that all artificial butter exported shall be marked as such on the packages in which it is sent, but if that is the case there must frequently be inside and outside cases, as the artificial butter comes here in perfect imitation of every kind of butter known on the London market, packages, muslin, and all accessories included, from Burro di Milano to Beurre d'Isigny and Extra Danish. Of course, the only persons deceived in general are the ultimate purchasers—the consumers.

Estimate of Imports.—Mr. Seldon, the Principal of the Statistical Office at H.M. Customs, informs me that there is no record of the quantity of artificial butter imported into England; and it appears that a very close analysis is necessary to determine what is real butter and what is butterine, or artificial butter. This is unfortunate, as I feel convinced that if the amount could be ascertained it would startle every one by its magnitude. In 1879 the importations of foreign butter amounted to about 2,000,000 cwts., of which 655,000 came from the Netherlands. Probably one-half of this was artificial butter, and if we estimate the quantity that is imported under its right name at about 200,000 cwts., we get a total of half a million cwts. of artificial butter. No doubt this is pure guess-work; but if it be considered

that there are manufacturers of artificial butter who send to England from 60 to 80 tons per week,—in fact, the three largest in Holland send between them about 200,000 cwts. per annum, —and there are at least 50 or 60 factories in the country, the quantity just estimated may be regarded as within the mark.

Effect on price of English Butter.—The effect of this competition upon the British dairy farmer is very serious. Last winter I was informed by a large factor that if it had not been for the importations of artificial butter the price of good fresh butter in London would have been at least half-a-crown per pound. Good artificial butter is much more palatable than bad real butter, and is quite as wholesome; and if it were sold for what it is, instead of for what it is not, neither the farmer nor the consumer could complain. The convictions of fraudulent dealers obtained from time to time scarcely touch the subject, as they chiefly refer to the selling of bad qualities of the article, whereas the best qualities of "Bosch" almost defy the skill of the analyst to prove that it is not real butter, however much he may suspect it.

XXVIII.—*On the Reclamation of Peat-land in the Netherlands.* By H. M. Jenkins, F.G.S., Secretary of the Society, and Editor of the 'Journal.'

[Reprinted from the 'Report on the Agriculture of the Netherlands to the Royal Commission on Agriculture.]

Different Kinds of Peat.—In the Netherlands peat-land is divided into two categories, known respectively as *Lageveen* and *Hoogeveen.* The distinction is based upon the relative height or depth of the land in relation to the sea-level. If the water-table is below the level of the sea, the tract of peat comes into the category of *Lageveen* or low-lying peat, but if the water-table is above the sea-level, then the area is deemed a *Hoogeveen* or high-lying peat. This distinction is accompanied by differences of legislative regulations, geological circumstances, and agricultural practices. But before describing them it should be stated that a peat-bog is of little or no value unless it is in, or can be brought into, direct water-communication with the general system of canals which traverse the country in every direction. Given this essential condition, a peat-bog may be worth 100*l.* per acre, more or less, according to the thickness of the peat; but if the canal has to be made, the estimated cost of its construction must be deducted from the fee-simple value of the land. One, and probably the only, reason why so much of the high-lying peat in Holland is still unreclaimed, is that such tracts are too far from any existing canal to render profitable their reclamation at the present time.

Low-lying Peat.—The low-lying peat, however, is for the most part reclaimed, as it lies in the western portion of the two provinces of North and South Holland, where water-communication is everywhere abundant. Nobody is allowed to dig peat from such places, unless the Government has a sufficient guarantee that within a certain time the site of the peat-bed will be converted into a polder, properly drained and brought into cultivation. These peat-beds generally repose on a clay-subsoil, and rarely attain any great thickness. The system is to excavate the peat, rejecting the top soil, and generally also a portion of the uppermost layer of peat, and afterwards to mix these waste materials and the lowest stratum of peat with the clayey subsoil. The land is then sown for some years with the usual agricultural crops, such as colza (rape-seed), oats, potatoes, wheat, &c., perhaps continuing longer in arable culture for the purpose of growing carraways, flax, and other industrial crops, and finally being laid down to grass.

High-lying Peat.—The course of operations for reclaiming the Hoogeveen or high-lying peat is generally different, and presents great variety, according to circumstances of situation, local requirements, and probably also of soil and climate. This variety of peat generally rests on a sandy subsoil, but is sometimes of such thickness that the subsoil cannot profitably be reached. In any case, to bring the land into cultivation it is necessary to mix sand with a greater or less quantity of peat, whether the sand is obtained from the subsoil or imported from a distance. As these operations are being carried on in the Eastern provinces of the Netherlands on a large scale, I have thought it desirable to give descriptions of some typical instances, both where the peat is used for fuel and where it is not, and also where the land, when reclaimed, is devoted to woodland, to farming purposes, and to market-garden culture. Under all these varying circumstances, it should be remembered that the quality of the peat has very little to do with the result, but that its wet or dry condition is a most important factor. Dried peat cannot be mixed with sand or any other medium, and even wet peat requires a large addition of farmyard manure to the sand to enable a workable tilth to be produced.

Nieuweroord, near Hoogeveen.

Peat Working.—This extensive property belongs to the Messrs. Rahder, and is worked for the extraction of peat on the most approved systems. The peat consists of several layers of different qualities, which graduate into one another, the deepest and most valuable being the soft blue or blackish peat, which

makes the best fuel when extracted in the usual way by hand-labour. The *modus operandi* is as follows :—The top-soil and the upper layer of peat are both thrown on one side, and then the turves of good peat are cut into brick-shaped pieces by means of a kind of spade. The workings are arranged as a series of steps, so that the back cut is made when each step is formed. The workman then cuts the peat at the proper distances, vertically and transversely, and afterwards the turves are separated from the subjacent peat by horizontal thrusts of the spade, after which they are removed by the man working in concert with the cutter. The drying is done by placing the turves in the open, with intervals between them. After a time the alternate ones are taken out and stacked crosswise upon the others, and thus by turning once or twice, the turves become dried all round. Two men, or sometimes a man and a boy, will earn from 5*s.* to 7*s.* 6*d.* per diem between them in cutting and stacking from 2000 to 3000 turves, or from 2*s.* 1*d.* to 2*s.* 6*d.* per 1000.

Machinery.—Several machines are also used on this estate for the preparation of the turf for market, and in these cases the different layers of turf are mixed together, so that there is no waste, the top soil, of course, being always put aside. Each machine consists of a vertical cylinder, in which is a rotating shaft, carrying four horizontal arms fitted with vertical spikes. Two sets of arms are fixed at right angles to the other two, their positions on the shaft being alternate. By this arrangement, actuated by a steam-engine, the wet peat of all qualities (dug at random, as regards shape, by men using spades) is mixed together into one uniform mass. The peat is thrown into the top of the cylinder and eventually finds its way, when thoroughly mixed, to the bottom. It is then propelled along a smaller and horizontal cylinder by an Archimedean screw, which brings it, more or less in a state of pulp, to the orifice, which is fitted with a quadrangular opening in which two knives work longitudinally. The knives, therefore, cut the outgoing pulped turf into three strips, which are afterwards cut transversely into required lengths, on a movable plate, as they are projected a sufficient distance from the mouth of the machine, by a boy in attendance for the purpose. The plates bear on them the name of the owners, and the turves take the impression very readily. The turves are thus made in batches of three, imperfectly separated from one another, but as they dry the separation becomes complete. Girls take on barrows three groups of three turves each to the drying-ground, and the further process of drying is the same as for hand-cut peat. Although the good and the indifferent qualities of turf are

mixed together in the machine, it is asserted that the machine-made turf commands a price 50 per cent. above that of the hand-cut peat, although the latter consists of only the best quality, and therefore entails much waste. The turf-machines are set on rails, so as to be easily movable from one part of the property to another, and the rails themselves are easily taken up and reset. A narrow gauge portable railway, with broad waggons in proportion to the gauge, is also used to transport the turves from the field to the barges, which convey them all over the country. It should be added that some owners of peat-land state that the machine-made turf is chiefly used for household purposes, and that brick-makers and other users of peat on a large scale will not buy it. By far the largest portion of the peat raised in Holland is used in factories, and more especially for brick-making.

Canals and Cultivation.—In this, as in all other instances of peat-working with which I am acquainted, the first thing done is the excavation of a canal; and after the peat has been extracted, the last thing is to bring the land into cultivation. In this particular instance oaks and pines are planted, so that nothing need be said on this head, except that the proprietors are well satisfied with the result.

Labourers.—The labourers are said to be very improvident. They earn high wages from April to October, but in winter there is very little work for them, and they are often nearly destitute. The employer frequently finds himself compelled to make advances to them in the dead season, and he does not always get repaid in the summer. Mr. Rahder told me that even at the beginning of each week, their want of provision for the future shows itself in their luxurious style of living, while at the end of the week they not unfrequently find it difficult to buy even rye-bread sufficient for their wants.

Prince-Peel, near Mill.

This estate, the property of Mr. Nering-Bögel, consists of about 1500 acres of peat-land, situated near the eastern border of the province of North Brabant. Of the whole area more than half has been reclaimed, and of the reclaimed portion, nearly 500 acres have been laid down to grass. This estate is briefly described as an example of the reclamation of peat-land without excavating the peat for fuel or other purposes, whereas, in the case of Nieuweroord and other reclamations to be afterwards described, nearly the whole, or at least a great portion, of the peat is taken out and sold as fuel, before the land is brought into cultivation.

Mr. Nering-Bögel bought the estate in 1864, but he did not begin to bring it into cultivation until the year 1870. In the meantime he studied the question of reclamation on the spot, wherever he could hear of successful operations being carried out. The system which he at last adopted was in some respects, especially the wide ditch arrangement, borrowed from Germany. It may be described as follows:—

Reclamation Works.—The peat has a thickness of from 20 inches to 5 feet, and rests upon sand. Ditches about 16 feet wide and 8 feet deep are cut 80 feet apart. The sand underneath the peat, and the peat itself that is dug out of the ditches, are spread over the peat on the intervening lands, after they have been dug by the spade and a quantity of sand has been brought to the surface. These operations cost from 6*l.* 10*s.* to 20*l.* per acre, according to the thickness of the stratum of peat. The ditches do not discharge direct into the main carriers at the sides of the roads, except through pipes which are laid under a continuous headland. Although there is a fall of 45 feet in summer from Prince-Peel to the river Meuse, and somewhat less in winter, pipe-draining is impossible, as the land is so flat that no local fall is obtainable; and the water-table is so near the level of the soil, that the pipes would only keep the subsoil wet instead of making it dry.

Improvement of Soil.—Sand and peat will not mix easily together, and it is useless to try to mix them unless large quantities of farmyard-manure are applied. This greatly facilitates the process, but artificial manures have no such effect. Newly reclaimed land is first sown with oats if it is ready in the spring, and with rye if it is ready in the autumn. The course of cropping generally pursued is as follows:—(1) oats and clover; (2) clover; (3) rye; (4) swedes, mangolds, potatoes, and some oats on the best land. Every crop is manured either with farmyard manure or artificials. Mr. Nering Bögel uses 30 tons per annum of home-prepared dissolved bones; and when farmyard manure is lacking, he uses from 1½ to 3 cwt. of nitrate of soda per acre. He finds that the nitrate of soda goes through the sand but is retained by the peat. The great object in view is to lay the land down to grass as soon as possible, but this cannot be done until it has borne at least four crops. He says that he has frequently had two tons of hay per acre off well-manured land. Two-thirds of the grass is mown annually, and this portion is nearly always dressed with a compost of soil and manure. Eventually the grass resolves itself into a mixture of alsike and white clover, with some red, together with *Holcus lanatus.* The cultivation of root-crops is somewhat singular. Both swedes and mangolds are sown in seed-beds in March and

April, and are transplanted in June, because he cannot get his land clean under the English system. The crops are grown on the flat, and seldom exceed eight tons per acre for swedes, which he prefers to mangolds, as being drier, although the crop of the latter root is much larger. Mangolds are used for cows up to January, but they are found to lose their sugar if kept longer.

Cattle.—One hundred cows and fifty young cattle are kept. Calves not wanted are sold to small farmers in the neighbourhood. They never suck, but are given milk in buckets for three weeks, then skim-milk by degrees, the milk being always warmed. The cows are turned out on the pastures the end of April or beginning of May, and kept there until the end of October or beginning of November, after which time Mr. Nering Bögel considers that the grass is injurious. During the hot weather they go into the stables in the middle of the day, and get cut green clover. In winter the cows are fed upon a mixture of chopped hay and straw, with 10 lbs. per head of maize and 4 lbs. of linseed, both crushed and cooked. This mixture is given in two feeds, and in the interval they get long hay or straw *ad libitum.* The cows are milked morning and evening, and are said to give an average of over 3 gallons (14 litres) of milk per head per day over the whole year. Formerly the milk not required for home purposes was sold to a butterine factory at 7 cents per litre, and the account amounted to 25,000 guilders per annum. This alone, on an average of 100 cows, shows a sale of 700 gallons of milk per head. Now, the milk is retained on the farm, and used for the manufacture of artificial butter at home, and this is found to pay better than selling it, or making it into real butter. The details of this part of Mr. Nering Bögel's operations have been described (p. 439) under the head of "Artificial Butter." At present there are four homesteads, but four more are about to be erected, so that the cattle may be more divided and much cartage of manure may be saved.

Sheep.—Six hundred sheep are fattened annually. They are bought in Germany as stores in May, and sold fat in November. As a rule they double their weight in the six months, and as the price per kilo for fat sheep is usually higher than for lean, they generally pay very well, being kept entirely on the grass, without artificial food. In 1879, however, the lean sheep in May cost more money than they fetched in November.

Horses.—Twenty-five horses and twelve working bullocks are kept to do the work of the farm and that connected with the reclamations, which are constantly going on. Mr. Nering Bögel considers that bullocks are more economical than horses, as he contends that the former are stronger and grow into money, while the latter are weaker and depreciate in value. The horses

are fed on hay *ad libitum*, with 5 lbs. of oats three times per diem, winter and summer alike, as they are always at work. The working oxen have the same feed as the cows, but beans are substituted for linseed.

Threshing is done by steam, with a Ransome's machine, and a portable engine by a Hull firm. Most of the oats grown are used on the farm, but most of the rye is sold. The marketable produce of the farm consists, however, chiefly of mutton, beef, and artificial butter.

Labourers.—There are always about 100 labourers employed on the farm; some few are lodged in the farmhouses, but Mr. Nering Bögel does not like the system. Ordinary labourers get 1*s.* 8*d.* per day, and are found in work all the year round. When there is no farm-work on hand, the process of reclamation is resorted to; cleaning out the ditches also provides work for a large number of men in the winter. The labourers work ten hours per diem; and when they make overtime, as during harvest, they are paid 3*d.* per hour for the extra work. There are no other privileges or additional emoluments during harvest.

Willows.—Mr. Nering Bögel has recently commenced growing willows, and last year sold some three-year-old poles on the spot at 10*l.* per acre, the purchaser to cut and carry them. Considering the quality of the land, and that very little labour or attention had to be bestowed on the willows after the first planting, this experiment must be regarded as having paid very well, especially as the purchasers were quite satisfied with their bargain.

Extensive Farming.—Such is a rapid sketch of the reclamation of peat-land, and its adaptation to what is on the continent termed "*extensive*" farming. The farming is on a large scale, with a large proportion of grass-land, and all kept in the hands of the proprietor. Manure is abundantly used for improving the quality of the pastures and the hay, and with the aid of artificial food for increasing the quantity of milk, which is used on the spot for making an article of commerce which ordinarily competes successfully with the produce of the farm. The next estate to be described presents a complete contrast to this picture, as it is designed to become a perfected example of "*intensive*" culture in the hands of owners or tenants of moderate acreages, employing a very large capital per acre in the production of market-garden and industrial crops.

Helena-veen (North Brabant).

Description of Property and Owners.—The tract of peat-land, known as the Helena-veen, is the property of a company called

the "Maatschappij tot exploitatie der Peel genaamd Helena-veen." The director is Mr. G. van der Griendt, of 's Hertogenbosch, and the resident manager is Mr. Schellings. Both these gentlemen did all in their power to facilitate my inquiry, and to the latter I am specially indebted for devoting a long day to showing me everything of interest connected with both the working and the reclamation of the peat. Before describing this estate, I ought to mention that it is the most striking and most successful example that has come under my notice of the application of a large capital to the cultivation of peat-land.

The estate comprises 2,250 acres, and the capital of the Company is nearly 60,000*l.* (700,000 guilders). Every year 10 per cent. of the net profits is reserved as an addition to the working capital, and about 8000*l.*, have thus been applied. Still the nominal capital on which dividends are payable remains at its original figure. The dividend paid has generally been at the rate of 5 per cent. per annum. In some years it has risen to 6 and even 7 per cent., but the last three years it has fallen to under 3 per cent. The agricultural success of the Company must not, however, be measured solely by the amount of the dividends, because a large proportion of the capital has been expended on permanent works which yield little or no monetary return at present, but which are nevertheless essential to the reclamation of the peat-land.

Canals.—Thus the Company has made between twenty and twenty-five miles of canals, and recently they have purchased a strip of land, about 300 yards wide, which will enable them to extend their main canal close to the newly opened railway station of Helena-veen. For years they had been trying to purchase a strip of land from the adjacent Commune of Deurne to enable them to make a canal to the station of that name, which has long been in existence; but from some unexplained reason the Commune would not sell the land. The new station of Helena-veen is only half the distance from the estate that Deurne is, and it is expected that the canal will be finished in a few months. A small steamer already plies on the main canal, and when the water communication with the railway is completed, the cost of carriage of produce (which over peat-roads is now very great) will be materially diminished. Thus the profits will be larger, while its greatly increased accessibility will add materially to the capital value of the land.

The strip of land bought for the canal being, as already stated, rather more than 300 yards wide, and the canal itself not occupying more than one-third of its width, a strip of land on each side, having a depth of 100 yards, will remain the property of the Company. This is sufficient to enable them to make a

road, and to lay out the land in building plots on each side of the canal, which also will continue their own property, and yield an increasing revenue in tolls. The importance of these considerations will be better understood after a study of the short space devoted presently to a description of the Groningen "Colonies."

Area under Cultivation.—At present about 200 acres are cultivated by the Company, and an equal area by the labourers and officers. The stationary population numbers about 400, of whom between 200 and 300 (including men, women, and children) work on the estate. In the summer large numbers of work-people come from North Holland and from Germany to dig peat, and make up the total number to between 700 and 800.

Mode of Reclamation.—The mode of reclamation of the peat-land is as follows:—After a certain depth of peat has been taken out—generally from 3 to 6 feet—a layer of sand, 3 to 4 inches thick is mixed with the replaced surface-soil by means of the spade, and a heavy dressing of street-manure is given; and each succeeding year the land is cultivated to a slightly greater depth. Manure, sand, labour, &c., cost about 20*l.* per acre; but after five years' culture agricultural land is considered to have paid all its expenses, and to remain as property acquired for nothing. In some parts of the estate the layer of peat is very thick, but it rarely pays to take it out to a greater depth than 6 feet. In many cases, therefore, the undisturbed peat remains the subsoil, and acts like a sponge, retaining moisture for the roots of the plants when those roots descend in search of it, but at the same time never becoming super-saturated, as any excess flows off into the adjoining ditches, which here, as in other peat-reclamations, are an essential part of the system. About twenty-five acres per annum are added to the cultivated area, the limit being imposed by the want of hands to reclaim a larger acreage.

Tobacco.—Of the 200 acres of reclaimed peat-land cultivated by the Company, forty acres are cropped continually with tobacco. Although always grown on the same land, the broad ridges of one year (carrying two rows of plants) become the equally broad trenches of next year. The manure used is sheep-dung, with very little straw amongst it, and the value of the annual dressing is estimated at 10*l.* per acre. It is put in the trenches in the spring, and then the land from the ridges of the previous year, and always a little more of the peaty subsoil, are turned over to make the ridges of the next year.

Tobacco-plants are raised in frames, covered with oiled paper, and are planted out towards the end of May. The leaves are harvested by plucking them two or three times, the

first picking possessing the best quality. The men who do the work get half the proceeds for their labour, which includes ploughing and other acts of cultivation, sowing, weeding, harvesting, and drying. The Company finds manure, seeds, frames for raising the plants, implements, and the barn for drying the leaves. Each barn is designed to dry the produce of about 6 acres, and there are 7 for the 40 acres or so which are annually cropped with tobacco. At each end of the barn is a cottage for the labourers, and two men are considered enough to do all the labour for the six acres. Thus the same two men always work together, cultivate the same land, use the same barn, and divide half the crop, or its value, between them.

Other Crops.—The remaining 160 acres cultivated by the Company are farmed as a rule on a four-course shift, viz.:—(1.) Potatoes with a double dressing of manure. (2.) Oats, rye, or wheat, with a single dressing of manure, and sown out with clover. (3.) Clover manured in spring. (4.) Flax without manure. There is also a little permanent pasture, which reduces the area of each break to something under 40 acres. The first four years after reclamation the cost of the manure is about 6*l.* 10*s.* per acre for the whole course, and after that period about half as much. The manure used on the estate consists almost entirely of the street manure and vendange of 's Hertogenbosch, which is brought as a return cargo by the barges which deliver the peat. The Company pays a small sum annually to the authorities of the town for the monopoly of the manure.

As about 25 acres of land are brought into cultivation every year, I was able to examine a piece of land which had been just reclaimed and had been planted with potatoes as a first crop, a second sown with oats as a second crop, a third-year piece bearing a crop of clover, and a fourth-year field with its plant of flax. The gradual improvement in the agricultural condition of the land could be easily seen; the crops looked remarkably well, and the year then (June 1880) promised to be a productive one in that locality. Potatoes are said to average 8 tons per acre, wheat and rye from 27 to 33 bushels per acre, and oats give a very much larger yield. The seed corn is generally obtained from Mr. van den Bosch at the Wilhelmina Polder.

Sheep.—About 400 to 500 sheep are bought annually. During the summer they run on the roads and other more or less waste places. In the winter they are fattened in sheep-stables on beet-root-pulp, oats, linseed-meal, &c., and sell at from 2*l.* to 2*l.* 6*s.* 8*d.* per head, the best going to England, and the rest to Belgium. Very little straw is used for their bedding, and the manure is used exclusively for the cultivation of tobacco.

Market-gardening.—Mr. Schellings has about 20 acres devoted to the growth of market-garden and fruit-crops. Some of this land he bought of the Company at 66*l.* per acre, and some of it he rents at 5*l.* per acre. A few acres, belonging to a neighbouring commune, he purchased at 33*s.* 4*d.* per acre, and he spent in one year 30*l.* per acre in labour, manure, &c., in reclaiming it. This land now bears splendid crops, while all round it the country is a mere wilderness, not to say a desert. He considers that his garden is now paying him back some of the capital which he has invested in its cultivation, and that the land is worth to a purchaser double the amount that it has cost him. The produce of this market garden often realises as much as 80*l.* per acre, but then the cost of manure and labour frequently amounts to 50*l.* per acre, of which about two-thirds are paid for labour. The cost of the plant, more especially of the frames, is also very great.

Succession of crops.—Each year the land carries two, three, or more crops, and the following are specimens of the succession taken on the same land in one year:—

A. (1.) Cauliflowers planted in spring, with (2) runner-beans, either flageolets or haricots, sown between the rows, and (3) endive and celery planted between the beans, after the cauliflowers have been sold.

B. (1.) Potatoes; (2) runner-beans between the rows as before; and (3) endive and celery taking the place of potatoes as they are dug and sent to market.

C. (1.) Carrots, which are sown mixed with leeks, and sometimes also with cabbage lettuces. After the carrots are marketed, the lettuces develop themselves, and finally the leeks, which remain until the winter, as this vegetable is not blanched in Holland as it is with us.

D. (1.) Peas with radishes, spinach, &c., between the rows; (2) the small seeds are succeeded by Brussels sprouts; and (3) peas are succeeded by endive.

E. (1.) Potatoes, followed by (2) late cauliflowers or Brussels sprouts or beet.

F. (1.) Early potatoes planted in rows wide apart; (2) intervals between the rows of potatoes sown with cucumber seed in the middle of May, the produce to be used as gherkins for pickling; (3) after the potatoes are lifted (in the middle of June), cauliflower plants are pricked in; and (4) after the gherkin plants are cleared away the ground is occupied by salads. This mode of cropping requires, it need scarcely be added, a very heavy dressing of manure.

G. This is rather a special system of cropping, and may be shortly described as follows:—Cauliflowers having been sown

in a frame in September, the plants are transferred to a cold pit in November. In January or February they are shifted to a hot-bed, in which they are planted about 8 inches apart. Between them carrots are sown, and cabbage lettuces are planted. The lettuces are pulled in March and the glass is then taken off. In May the carrots are pulled, and in June, or even earlier, the cauliflowers being ready, the alternate ones are cut and the remainder are left to run to seed. An acre of land would yield, on an average, from 100*l.* to upwards of 130*l.* in cauliflower seed, but Mr. Schellings has only about a quarter of an acre devoted to this description of culture. The mean price received for the seed is about 6*s.* per lb., but it ranges between 4*s.* 6*d.* and 9*s.*

Fruit-trees.—Mr. Schellings has also 5 acres of land planted with fruit-trees, which are chiefly apples and pears, with bushes of gooseberries and currants, and canes of raspberries between them, while on the walls separating the sections of the garden, grapes are cultivated as in the Poeldijk district of Westland, just as the vegetable culture is an imitation of the practice of the Loosduinen section of the same district.

Labour.—The labour question has received the most careful consideration from the managers of the Helena-veen Company,—it may be because they are very desirous to attract good labourers, and especially those with large families, to settle on the estate. However that may be, their care for the moral and material welfare of the stationary labouring population is worthy of all praise, and the condition of these labourers stands out in bold relief to that of the ordinary agricultural labourer in most districts of the Netherlands. Nearly all the farm work is done by the piece, but an average industrious man can earn about 35*l.* per annum; a strong lad of over 16 years of age can earn 25*l.*; and young women almost as much. The labourer can hire from the Company a cottage and about an acre of land for 3*l.* to 4*l.* per annum, according to the accommodation provided. There are other and somewhat unusual regulations and facilities, some of which deserve special notice.

Contracts with labourers.—The Company have made compacts with their labourers and with their public-house tenants, prohibiting the latter from selling, and the former from buying any spirits, except on Sundays before noon. Any infraction of this rule, if discovered, is immediately followed by eviction of the publican and the labourer, and the discharge of the latter from his situation. Beer, however, is allowed to be bought and sold at any time. The Company has also established a means of enabling the labourers to purchase their cottages and allotments by periodical payments to cover principal and interest, and they

have found this plan a great incentive to industry and to habits of economy. In some cases, also, they have given a deserving labourer a cottage and piece of land rent free for ten years, on condition that he brings the land into a proper state of cultivation, to the satisfaction of the manager, within a stipulated time, and keeps it in a state of good culture during the remainder of the period; but he can be evicted at any time if he infringes the Company's rules, and if he dies his family have no claim upon the Company for the improvements which he has made, or otherwise. In fact, the Company does not surrender, in any respect, its proprietary rights, but what it does in this way is merely an act of grace. Still, the effect has hitherto been most beneficial to the labourers; some few are even beginning to cultivate tobacco on their own account, and to imitate the managers in their market-garden operations.

Results.—Mr. Schellings assured me that he was quite satisfied that the labourers on this estate were much better off than the peasant proprietors in the neighbouring districts, because the former always have money either to spend or to save, and they are sober,—originally by compulsion, but now by habit,—whereas the peasant proprietors live on the produce of the soil, have very little surplus to sell, and therefore very little money to buy things not produced on the farm; while, of the little money that they become possessed of, a large proportion is spent in drink (Geneva).

Peat workers.—Against this somewhat rose-coloured picture of the condition of the constant labourers on this estate, must be placed that of the peat workers who come, as already stated, every summer. A good workman cutting peat can earn as much as 4*s.* per diem, but some only gain 2*s.* 6*d.* Those not sufficiently skilled to do the cutting, can earn from 2*s.* 6*d.* to 3*s.* 4*d.* per diem on other portions of the work of peat-winning, while women and boys earn from 1*s.* 3*d.* to 2*s.* per diem. It must be understood that these high wages are earned only during the peat-cutting season, which lasts three months. The migratory labourers are all men, and they live in small cabins on the peat-beds. Each cabin holds from 8 to 12 men, and the Company provide them each with a sack of wool as a bed, and a blanket as a covering, also certain necessary articles for the *ménage*.

Contrast with other peat-lands.—The contrast between this "Veen" and the reclaimed peat-lands already described is so great, that an explanation will naturally be sought for. Mr. Schellings declares it to be his opinion that nothing but the application of a sufficient amount of capital per hectare is necessary to enable Hoogeveen, Prince-Peel, and other high-lying

peat lands, to be brought to as high a state of productiveness as Helena-veen. Eventually the Company will sell or let the reclaimed lands, and I was informed that now farms of 50 acres, on which tobacco, flax, and market-garden crops, as well as ordinary farm produce, can be grown, could be hired for a term of years at about three guineas per acre.

The Veen-Colonien.

Origin of the colonies.—In the province of Groningen are several large villages, such as Veendam, Oude Pekela, Nieuwe Pekela, Stadtskanaal, &c., which are situated on both sides of a series of canals, made for the most part about two centuries ago. These canals run through what was a district of peat-land similar to those already described, and the canals appear to have been made by the authorities of the city of Groningen for the purpose of transporting to a distance the town manure. The authorities purchased certains tracts of land to enable them to carry out their scheme. In some cases they purchased, or perhaps eventually retained, only a strip of land sufficient for the canal, a road on each side, and a house and garden beyond. In other cases they retained their proprietary rights over considerable tracts of land. The colonists of this wild and hitherto uninhabited region in many cases purchased land either independently of the authorities of Groningen, or more or less adjacent to small portions which they leased from the latter. Thus at the present day the farmers may be classified as follows:—

Owners and copyholders.—(1.) Proprietors in fee-simple of the whole of their land, farm-buildings, &c.

(2.) Proprietors in fee-simple of a greater or less portion of their farms, and Beklemde-meijers, or hereditary leaseholders, or copyholders of the land on which their house, garden, &c., are situated, with perhaps a portion of the farm.

(3.) Tenants for a short term of years (generally six), the land being let by public tender at the expiration of the lease.

The strips of land abutting against the road which runs alongside of the canal, are generally about 250 feet in depth, and the Beklemde-meijers pay an annual rental to the city authorities of about 4*d.* per running metre (nearly 40 inches). For agricultural land let on this peculiar tenure, the rent is about 1*s.* 8*d.* per acre. In the case of a sale of the Beklemming (or copyhold), a percentage of the purchase-money must be paid to the city authorities; generally this is 5 per cent., but at Veendam it is only 3 per cent., and it may also vary in the case of "colonies," with which I am not acquainted. On the other

hand, there is no fine payable as a succession-duty, if the succession is in the natural order of heirship, and the so-called "rent" cannot be altered. The rent of farms let publicly at their ordinary value, without any Beklemregt attached to them, has hitherto been about 50*s.* per acre, but the last two or three years it has fallen about 30 per cent.

Mode of Reclamation.—The mode of reclamation of the peat-land in this district is practically the same as that carried out, as already described, at Helena-veen; but there are certain peculiarities in the disposition of the canals and subsidiary ditches which should be mentioned. The farm-houses generally face a main canal, and are placed in the centre of the frontage of the plot of land which constitutes the farm, and which is bounded on one or both sides by a lateral canal. An ordinary farm would have a width of about 250 feet, and a length of 1½ to 2 miles or more; there would be a lateral canal running alongside one side of its whole length, and cross canals at intervals, dividing the farm into pieces of 1 hectare (2½ acres) each. Thus access to every field can readily be obtained by the lateral canal, while the transverse ditches help the drainage of the land.

An Example Farm.—Mr. Borgesius, the burgomaster of Oude Pekela, and author of a valuable pamphlet on the Veen-Kolonien,* has a farm which is 500 feet wide and 3 miles long. The first 1½ mile, nearest the homestead, is held from the town of Groningen, subject to a payment of 1*s.* 8*d.* per acre per annum, and the usual fines on sales, &c. The remaining strip, 1½ mile in length, is peat-land now in course of reclamation, and is his own property. The authorities of Groningen stipulate that manure to the value of at least 50*s.* per acre shall be applied periodically to the farm-land, and it is frequently stated what acreage of the farm must be kept in permanent pasture, how much land may be cropped with potatoes, and how many head of cattle must be maintained on the farm. As the primary object of the authorities in making these colonies was to find an outlet for the town manure, the object of that regulation can easily be understood; while as regards the growth of potatoes, it should be explained that this is the staple crop of the district, in consequence of the existence of so many starch factories in the neighbourhood.

Mr. Borgesius's farming is quite a type of that prevailing in the colonies. A three-course shift is adopted, viz., (1) potatoes, (2) beans or peas, (3) rye or wheat, sometimes oats, sown out

---

* Urbarmachung und Landbau in den Moorcolonien der Provinz Groningen, von T. Borgesius. Übertragen von W. Peters. Osnabrück, 1875.

with clover, which stands two or three years. This is done when considered necessary, say once in ten years. Then potatoes are taken again, and perhaps twice in succession. Very few cattle are kept, but large quantities of street manure are bought in Groningen, at 100 guilders per last of 1600 kilos (equal to about 5 guineas per ton), and also stable manure from the Dollard Polder in North Groningen, at half the above rate. Manure to the value of between 6*l.* or 7*l.* per acre is thus applied to the land once in the ordinary shift of three or four years, with the result that a good crop of potatoes is between 6 and 7 tons per acre. Some kinds of potato yield 22 per cent. of starch, but the American kinds yield only 18. Mr. Borgesius and his neighbours sell all the straw that they do not require for their horses and cattle to the paper (carton) factories in the neighbourhood, at 25*s.* per ton, and in case of a glut or low prices, it is pressed and sent to England.

Value of Land.—The value of land in this district, subject to the small payment to the town of Groningen, was until 1877, 50*l.* per acre, but since then it has fallen one-third. Labourers working on the farm earn from 1*s.* 3*d.* to 1*s.* 6*d.* per diem, and double as much when working the peat in the months of April, May, and June. Most of them hold their cottages and gardens from the city of Groningen, on the same kind of tenure as the farmers hold their land; but the authorities find great difficulty in collecting their rents from these small occupiers, especially in bad seasons and when work is scarce, so much so, that they have in their employment a procureur and an avocat, whose duty it is to enforce payment.

The constant labourers receive, in addition to their money wages, from 40 to 50 or 60 bushels of potatoes free of charge.

Foul Fields and Clean Houses.—At the time of my visit to this interesting district (June 14th and 15th, 1880), the potatoes were very backward in appearance—the haulm having been twice frost-bitten, and some fields were very foul. Beans looked stunted, but oats were good. Much of the grass-land was infested with nettles, and altogether the farms did not present a strikingly fertile and well-cared-for appearance. On the other hand, the farm-houses, down to a certain size, were models of cleanliness and neatness, but the smaller ones (said to belong to labourers, who also cultivated a little ground) presented the reverse of the medal.

Property held by City of Groningen.—It must not be inferred that all the land let under the system of Beklemregt belongs to the city of Groningen, for very many farms are held under that peculiar tenure from private individuals. It is not necessary here to enter more into this question, as it has already been

sufficiently discussed in the chapter on Land Tenure.* In addition to the revenue which the city of Groningen derives from the annual payments of 1 fl. per acre by the Beklemde-meyers, and of the ordinary rents by short-term leaseholders, must be noted the tolls paid by barges and other vessels using the canals. From the budget of the city for the current year, it appears that the receipts from the leased lands were estimated at over 13,000*l.*, and the total receipts from the Veen Colonien proper at 21,760*l.*, while on the other hand, the disposal, &c., of the town manure was estimated to entail a charge of nearly 6000*l.* It should be added, however, that in the sum first mentioned is included the rent of some very fertile land in the celebrated Dollard Polder, in North Groningen.

Inland Docks.—These Veen-colonien were in the old days great ship-building places, and many old sea-captains still live there, and pursue this or some other congenial calling; but the ships now built are entirely barges, fitted to ply on the canals, steam having entirely swept away the rest of this trade from these curious inland docks. It would be interesting to learn the date at which the old and still favourite type of barge was first introduced. It must be eminently well-fitted for its purpose, as there is very little variation amongst the thousands that ply on the maze of inland Dutch waters.

XXIX.—*Report of the Judges on the Derby Prize-Farm Competition*, 1881.

The district of the prize-farms last year comprised the entire counties of Cumberland and Westmoreland. This year the limits of competition extend to the whole county of Derby, and embrace any farm lying within 20 miles of the county-town. This district therefore extends to portions of four other counties besides Derbyshire, and its limits are not readily defined or easily portrayed.

Unlike the picturesque and compact district reported on so eloquently last year by Mr. Little, we have nothing special to write of the geological formation, natural boundaries, special industries, or peculiar agriculture of the district. It is simply an average slice of the Midlands with its big towns and its mixed farming. Not much of the scenery is such as to call forth any of that "word painting" by which the reporter so charmingly diversified his last year's essay, making its perusal such a pleasing as well as useful study.

---

* *Vide* Report, p. 650.

But lest we should be thought unmindful of the minor beauties of this more level district, let us state that the charming views along the valleys of the Derwent and the Dove, the noble Trent with its broad expanse of meadows, the hills and dales of Ashbourne bordering on the Peak district, the lovely scenery around Stretton, and the grand old ruins of Croxdon Abbey with its interesting mediæval relics, did not escape our notice and admiration.

But we must at once come to the prosaic record of the chief agricultural features of the district, and give a commonplace description of all the farms we visited.

Mr. Little had to report the curious and happy fact that the agricultural depression which was so common in the south-east and middle parts of England had not reached such northern limits as Cumberland and Westmoreland. We are glad to be able to report that we failed to detect the intensity of that extreme depression in the districts around Derby. Mr. Little suggested some excellent practical reasons which would account for the flourishing condition of the husbandry of the locality he inspected. Among other facts that seemed to tell in favour of the Cumberland and Westmoreland farmers, Mr. Little put the good quality and great weight of the roots grown, the flourishing condition of the oat crop, the absence of couch-grass without any special pains taken for its eradication, the goodness of the labour and the lowness of the rates. We do not deny that some of these blessings are enjoyed by the farmers around Derby, and we contend that they are equally frugal and industrious as their northern brethren, but the salvation of the agriculture of the district inspected by us we should sum up in one word as *Milk*. Furthermore, we would state that the best style of common farming—growing corn and meat—if ever so well done, with plenty of capital judiciously expended, the greatest assiduity and industry on the part of the tenant, and under other favourable conditions, does not pay with rents, labour, and outgoings as high as we found them. Nothing more was yielded than a beggarly percentage, not equal to that secured by an investment in the Funds; while those who produced milk were able, after defraying all their personal and household expenses out of the farm, to show a solid profit that would more than equal the best times and seasons of arable farming.

It is supposed that the success of a dairying district depends in a measure upon a heavy rainfall. The rainfall of Derby is by no means excessive, the average hardly reaching 26 inches a year, which is less than that of many Midland counties, and not much in excess of the dry districts of East Anglia. It is the soil and locality, rather than the rainfall, which renders the

production of milk the most paying part of Derbyshire farming. There is also nothing to note in elevation of the majority of the farms inspected, as many of them border the Trent, and the Midland Railway Station at Derby is only 174 feet above the sea-level. Through the courtesy of the President of the Board of Trade, we are enabled to give the Agricultural Statistics of the present year. The figures for 1881, we are officially told, "are the approximate returns before examination, but these corrections, as a rule, do not affect the substantial figures," and are sure to be accurate enough for the purpose of our rough comparison. (See Table opposite.)

It is satisfactory to find in these returns that something is stationary. The total area of the county happily remains the same as it did ten years ago, but in 1867 Derbyshire was said to contain 658,803 acres, which showed a loss in four years of 2600 acres somewhere. But while the total acreage was so much larger than it is now, the area under cultivation was in 1867 only 477,000 acres as against 495,000 acres in 1871, and 512,000 acres in 1881. We can hardly credit that there has been any such increase as 35,000 acres of crops, fallow, and grass, in fourteen years, or the lesser one of 17,000 acres in the last ten years. No doubt the difference is mainly due to the increased accuracy of the returns, and the greater pains which a larger number of farmers exercise in filling them up. It is not such an easy matter for a farmer with several holdings, or the illiterate occupier of a small farm, to make out these returns with perfect accuracy. The difference between landlords' and tenants' measures where fields are small and hedgerows wide, where wastes, roads, and frontage, are measured into the farm, is often as much as 20 per cent., while the contents of certain fields which pass for so many acres upon a farm, vary much from the exact area under cultivation. Still, for all purposes of comparison, these statistics are most useful, and may be depended upon as not only substantially, but actually correct. They disclose the fact that there are about 10,000 acres less wheat now in Derbyshire than there were ten years ago. The decline in the growth of wheat seems to have been more rapid of late years, and not to have begun much before 1871, for the area returned in 1869 was almost the same as in that year. Barley, which generally keeps up its area better than any cereal, shows a falling off of nearly 3000 acres, but the decline in oats is very trifling. It is curious in the summary of the Agricultural Returns for Great Britain just published, that oats, which as late as 1879 had a less area than our wheat crops by nearly 250,000 acres, have this year more than 100,000 acres in excess of the wheat, showing how low prices, wet seasons, and

POPULATION; ACREAGE under CROPS, BARE FALLOW, and GRASS; and NUMBER of CATTLE, SHEEP, and PIGS, in the COUNTY of DERBY in each of the YEARS 1871 and 1881.

	1871.	1881.
Population	379,394	461,141
	Acres.	Acres.
Total Area	656,243	656,243
Total Acreage under Crops, Bare Fallow, and Grass ..	495,678	512,334
Corn Crops :—	Acres.	Acres.
Wheat	32,844	22,537
Barley	15,763	12,833
Oats	28,635	26,927
Rye	305	101
Beans	1,714	994
Peas	2,839	548
Total of Corn Crops	82,100	63,940
Green Crops :—		
Potatoes	3,842	2,692
Turnips and Swedes	11,982	11,602
Mangold	1,920	1,773
Carrots	41	47
Cabbage, Kohl-Rabi, and Rape	2,613	1,784
Vetches, and other Green Crops, except Clover or Grass	4,170	3,066
Total of Green Crops	24,568	20,964
Clover, Sainfoin, and Grasses under Rotation	43,062	27,622
Permanent Pasture, or Grass not broken up in Rotation (exclusive of Heath or Mountain Land)	338,959	391,776
Bare Fallow or uncropped Arable Land	6,966	8,026
Cattle :—	Number.	Number.
Cows and Heifers in-Milk or in-Calf	59,738	64,722
Other Cattle :—		
2 years of age and above	22,912	25,677
Under 2 years of age	39,463	43,082
Total of Cattle	122,113	133,481
Sheep :—		
One year and above	147,973	126,137
Under one year old	81,834	65,106
Total of Sheep	229,807	191,243
Pigs	40,680	30,552

NOTE.—The figures for 1881 are given, subject to correction on further examination of the Returns.

bad farming have diminished the growth of wheat, and extended the cultivation of the more easily grown and more hardy oats. Beans in Derbyshire have in the decade diminished one-half, and peas are only one-fifth of the acreage grown in 1871. The supposed increased breadth of mangolds is not borne out by these returns; possibly upon farms where milk is sold the area is larger, and there is the further fact that the extent returned in 1866 was only 915 acres, not much more than half of the acreage in 1881. Cabbage is still lumped with kohl-rabi and rape. Of these latter crops we did not see a single acre, and the decline of more than 1800 acres may be in them rather than in cabbage. In 1867 the area of the three crops was only 1412 acres. It was to be expected that after so many wet seasons the extent of fallow or uncropped land should increase, and 1000 extra acres this season has, we believe, received a thorough good cleaning; but even the 8000 acres returned in 1881 contrast favourably with the 11,000 acres in 1866. The greatest change of all has been in the grass-lands, and here the increase of 53,000 acres was fully expected. But there is a further 14,000 acres to be added between 1867 and 1871, making a total addition to the permanent pasture of Derbyshire of 67,000 acres in fourteen years.

It is satisfactory to find that the cattle have increased by more than 11,000, about half the increase being in cows; but it is mournful to contemplate the loss among the sheep. In 1871 the numbers reached just 230,000, and now there are nearly 40,000 less sheep in the county; and if we go back to 1867 we find that the returns then stood at 258,000, showing a decrease of 67,000 sheep in fourteen years. The diminished area of arable-land would in no way account for this most serious falling off, as sheep are not kept to any great extent on the fallowed-land in Derbyshire; we fear the chief cause is the fluke-rot, and the minor difficulty of keeping sheep free from foot-rot in the sodden pastures of the county. The diminution of pigs from 47,000 in 1867 to 40,000 in 1871, and 30,000 in 1881, is not at all surprising when cheese-making has fallen off one-half, and the sale of milk has certainly been more than doubled in that period.

The development of the milk-trade is of quite recent growth. We have been unable to find any reliable statistics which should record its progress. A general opinion prevails, that around Derby not half as much cheese is made now as there was ten years ago. Again a very usual estimate is that of all the dairy farmers in Derbyshire, within five miles of a railway-station, quite half of them sell their milk. The Midland Railway Company inform us that in the year 1872 they carried over their

whole system 1,000,000 gallons of milk, and that this year they will convey 5,500,000 gallons, and the quantity is annually increasing. It is almost a misnomer to talk of dairy-farms in these days, when upon many of them the dairy is never used, and the cumbrous old presses and the other appliances for cheese-making are as obsolete as a flail or a horse threshing-machine, and as useless as Gog and Magog. The fear that the milk-trade will be overdone is sound, did we not believe that the populations of our great towns have only just begun to drink milk and to appreciate its necessity as an article of diet and of cookery. It is a taste which must grow, and its extended use among the children of our towns and villages will do much to build up a vigorous and healthy generation. It may be, that in spring there will be more milk produced than can be consumed, but provision must be made for this overplus, and we found some farms upon which cheese-making had to be resorted to for a few weeks in the early summer. When a farmer can retail his milk, as is the case at Markeaton Park, which is only two miles from Derby, the price received is very remunerative, but where he has to send his milk four miles to a station and to pay the carriage, the price he realises is not more than can be made of it in good cheese or butter. But there is the absence of any household bustle, and there are the weekly payments, which are very convenient. That last advantage holds good in the case of butter, and if there was a ready sale for skim-milk, or if it could be applied more profitably than giving it to pigs or calves, there is room enough for a good profit to be made by butter-making at present prices. For bread and biscuit-baking, and as an article of food, there ought to be a more general demand for flat or skim-milk, and it is also more valuable for cheese-making than it is for feeding animals upon a farm.

There was a scare, especially among landlords and agents, that milk-selling would soon ruin dairy-farms. There would be everything taken off and nothing returned to the land, not even the whey or the butter-milk, as when cheese and butter were made. No pigs would be kept, no calves reared, and no manure made. When milk is all sold to a cheese or butter factory, and no dairy refuse brought back, this may be the case; but the milk-seller has to supply pretty nearly the same daily quantity all the year round. Moreover, the price of milk is always dearer in the winter than in the summer months, and no farmer can produce an abundance of milk in the winter without the aid of artificial food. The most successful instances, both in the immense production of milk and in the financial returns, that we have recorded, show how largely purchased food may with a profit be used in the manufacture of milk. The late

Mr. Carrington was credited with being a generous, if not an extravagant feeder of his milch cows, but his purchased food (mainly decorticated cotton-cake) did not amount to more than 38*s*. an acre, while the annual expenditure upon the first and second prize-farms stood, respectively, at 60*s*. and 51*s*. per acre. It is utterly impossible with such an outlay that any land should lose its fertility; on the contrary, we believe that it must be not only transiently but permanently improved.

In the detailed report of each farm which follows will be found the exact quantities of the different kinds of food with which the cows and other stock are supplied. We would only make the general remark that decorticated cotton-cake seems greatly in favour, not only for its production of milk but for its excellent effect upon all grasses, especially those permanent seeds which are newly laid down. But the common use of brewers' grains, although well known to most cowkeepers, may not be so generally understood. There appears no food like them for the production of milk, and when mixed with more costly feeding stuffs the milk is not only abundant but exceedingly good. Take for instance the first and second prize large dairy-farms, where grains are used all the year round: at Markeaton 63 cows produced 710 gallons of milk each, and at Twyford 36 cows gave 921 gallons in the year. In the immediate vicinity of the great brewing town of Burton-on-Trent, grains of the best quality and in any quantity are to be had at all times of the year, but there is not so much demand for them in summer. In the winter, prices range as high as 6*d*. per bushel, and in summer they fall as low as 2*d*. Great pits from 6 to 10 feet deep are dug in the dry ground, and 5000 or 6000 bushels of grains are trodden in. When the surface is reached the grains are well heaped up in the middle, beaten down, cased with chaff or road-scrapings and then well covered with a thick coat of soil, so as to resemble a large mangold-hole. Sometimes these pits are lined with bricks, and more frequently a proper vault either above or under the ground is made. An old barn with brick partitions run across it makes a capital receptacle for storing grains. Some farmers use salt in packing the fresh grains, and are very particular in the covering that is applied to the surface; but it appears that if ordinary care is taken to exclude the air grains may be kept in the roughest manner and be perfectly sweet and good at the end of six or even nine months.

The sale of milk, instead of cheese or butter-making, is essentially popular with the females of the household. All they have now to do is to attend to scalding and cleansing the milk-tins. A milkmaid is unknown, for no woman troubles herself to milk. The milk never enters the farmhouse, but is

refrigerated in some convenient spot close to the cowhouse, placed in tin *churns* * and sent off either once or twice a-day to the nearest railway-station. If the animal heat is properly expelled from the milk, there is next to no risk in its turning sour in its passage to London. Some milksellers do not, even in the warmest weather, send it more than once a day. On one of the hottest days in June we saw the morning's milk that had passed through the refrigerator standing in a trough of cold water, waiting for the evening's meal to be ready, before sending to the station some three or four miles off. We were assured that not a gallon was ever spoiled, but during the hot weather the milk of the morning and evening must never be mixed; that seems fatal to its keeping sweet.

Whoever knows the labours of the dairy, the anxiety, the trouble, the constant never-ending hard work, will not wonder that milkselling finds especial favour with the farmer's wife and daughters. By the mouth of one of us, whose experience gives him a peculiar right to speak in the matter, we endeavoured to say a few words in favour of cheese-making, and now and then proceeded to argue the claims of butter, the value of skim-milk, the advantages of whey, the beautiful calves and the dear little pigs that could thus be reared and kept upon the farm. We were listened to with respectful attention, but with evident impatience. One and all seemed to be the deafest of deaf adders, and refused to be charmed for a moment. Having known the labours of the dairy, nothing but stern necessity would make them take to it again. This is only a part of the household economy of the age in which we live. From the mansion of the millionaire to the cottage of the peasant, anything that approaches hard work is voted a bother and should be passed on to some one else. In the homes of the middle classes, washing, brewing, baking, and dairying are regarded as nuisances by the majority of mistresses, and so shirked and muddled by servants, that it has become the fashion to entrust these domestic operations to outside establishments. And where skill and science are brought to bear upon every detail, it may be even more economical than trusting to that rule-of-thumb and happy-go-lucky way of solving domestic problems which is common in too many households.

The small expenditure in labour may strike many farmers. This is not all explained by stating that on the majority of farms the chief part of the land is in pasture. Nor can it be all accounted for by recording that the farmer not only supervises

* Churns are now frequently made of steel, tinned.

the labourers, but that he himself does a great amount of work, and that he is invariably one of the milkers.

The hours which the labourer works and the will with which he works are both in excess of what is usual in the western and eastern counties. A great number of hands are boarded and lodged in the farmhouse, and so are always upon the spot. Work all the year round commences at five, and does not terminate until late in the evening, with only half-an-hour for breakfast, and one hour for dinner. We are speaking now of what are termed hired farm servants, which upon most farms constitute the chief part of the labourers employed. The pay per day for other hands may be more than is common in southern England, but the amount of work rendered is still greater. It is nothing uncommon in the grain-growing districts of England for the labourer to earn 7*l.* in the corn harvest, which seldom lasts a month. In addition to this he has a chance of supplementing his usual wages with piece-work in the summer, and extra wages for the longer hours of haysel. In the districts we inspected we found that 3*l.* or 3*l.* 10*s.* was the common sum paid for the longer hours of hay and corn harvests, which often covered a period of ten weeks, when the labourer was expected to work from light till dark, with only a short respite for meals. But the good living of the farmhouse, the constant direction and superintendence of the master, and the real interest he takes in the work of the farm, all tend to make him a better and more active labourer.

It is difficult to apprize the value of the hard-working farmer's services, especially when the work of the hands is supplemented, as it was on all the farms we visited, by a careful, constant, and intelligent supervision of all details of his occupation. In reckoning the expenses of a farm too little value is frequently placed upon the services of such a tenant; for, however trustworthy and enlightened may be the foreman, he cannot expect to supply the head and eye of the master. The farmers of this description we met with, seemed to illustrate most forcibly the old proverb of "minding their own business, and leaving other people's alone." So much does the work and management of their farms seem to employ their time, that they have very little to devote to public or parochial business, or to any sort of recreation. They seem to thoroughly carry out the American's advice to his son: "To find recreation in looking after your business, so that your business will not be neglected in looking after recreation."

The *Cattle* were all Shorthorns, ranging from some most beautiful herds to a few very common nondescript milking

animals. At Croxden Abbey were a few cows only that had a place in the Herd-book; but even there, and certainly in all the other dairies, it was *milk*, and not *meat*, which held the first place. Now and then we came across a pedigree bull, but we were constantly told that those dairy-farmers who relied upon the Herd-book for their bulls, "soon pedigreed their milk away." The pure bulls used at Croxden had been selected with great care from Shorthorn tribes noted for their heavy milking properties; but it was only a few of the thoroughbred cows which proved themselves prolific milkers. It is a thousand pities that milk has been so little considered by most Shorthorn breeders. Doubtless the combination of meat and milk in the same animal is very difficult, and to transmit those qualities to succeeding generations is a harder problem than those who have not tried it might imagine. There are milking strains of Shorthorns containing as good dairy cows as any other breed; but the majority of prize-takers at an agricultural show hardly produce enough milk to properly rear a calf. There is no doubt of the bad repute in which pedigree stock are held by most dairymen, and our national shows have in a great measure created that prejudice. As a rule, blood, fashion, and beef carry off the prizes, and milk is nowhere. We must hope that the Dairy Shows will correct this mistake, for it would be indeed a national misfortune if, in our efforts to produce a perfect frame and exquisite quality of flesh, the prolific milking properties of our cows were altogether forgotten.

A few long-woolled sheep are kept; but by far the most numerous and profitable sheep appeared to us to be the Shropshires. Of these most excellent sheep we saw two or three very nice flocks, but the number of sheep around Derby has considerably diminished of late, and on many farms none are now kept. Sheep appeared to be allowed a pretty free run over the grass-land, and if many more were kept with such liberty, they would sadly interfere with the yield of the dairy. The Shropshire lambs were excellent, and many of them were quite fat, selling from 2 guineas to 46*s*. per head. Born in March, and fetching this price at the end of June, it appeared folly to keep them on through the winter. We also must confess that we were disappointed at the small progress made during the long period which elapses between July and May. The tegs were well wintered on cut turnips, hay, and cake, and yet did not seem to have grown or fattened upon such good keep as we should have expected. Even where there is a large extent of arable land the sheep are only fed upon the seeds during the spring and summer, and there is no attempt made to fold them on vetches or other green crops. Where the acreage under the

plough is very limited the whole energy of the farmer is naturally turned to providing the greatest weight of roots and cabbages for his cows; but where no such pressing need exists, it appeared to us that the pastures might be relieved by the sheep being folded upon some green crop during a portion of the summer.

We ought, however, to record a singularly successful instance of keeping sheep in the winter upon heavy arable land. It was impossible to feed off the roots where they were grown, as the sheep would so poach and puddle the soil as to spoil it for the following crop. So the swedes are carted to the two-year-old seeds, and there banked up. The sheep were folded upon these seeds without any detriment to the land, and had a clean and fairly dry lodging. The ley ground was afterwards ploughed up and sown with oats, which were the best crop we saw in our long rambles.

Consequent upon the general sale of milk, pigs are now so small in number as to be hardly worthy a passing remark. On one or two farms good big Yorkshire sows are kept, and where pigs are fattened on meal and whey, some strong stores, mainly of the Tamworth breed, are bought in, and appear to pay well for grazing, leaving 1*s.* per head per week for the whey they consume, besides paying for the meal.

The health of the cattle was generally excellent. In two instances we found the young stock upon the farm attacked with foot-and-mouth disease, but by careful isolation this tiresome malady did not extend to the dairy cows, and thus a far more serious loss was arrested. Upon only one farm did we hear of the ravages of pleuro-pneumonia, and there the owner took the most sure method of introducing the disease, not only to his own dairy, but into the neighbourhood. He went twice to Dublin and bought a lot of cheap cows, and twice lost all his stock. In all probability he won't try it again; twice bitten he will be surely thrice shy.

But the losses from fluke among the sheep have been most appalling. So great has been the destruction that upon some farms we visited no sheep are kept, while on many others the numbers are greatly reduced. Not only upon flooded lands, but upon pastures that never rotted sheep within the memory of man, has this plague been common in 1879–80. The effects are visible even now among some flocks, but we believe the plague is stayed. During the past wet seasons the foot-rot also seems to have been a terrible scourge to the sheep of this district.

The growth of cereals is not the main feature of Derbyshire farming, but it occupies such a position as to call forth a few remarks. The area under the plough sensibly diminishes every

year, and of all the corn crops wheat appears to be the least in general favour. Less is grown than formerly, but the wheat we saw, being well farmed, promised to be a good and, in a few instances, a great yield. Barley appears the most paying cereal. When planted early, great crops are grown, and when well harvested is a beautiful malting sample, and, lying near the celebrated Burton breweries, always commands a ready sale at high prices. We only found one instance in which last year's barley was sold for less than 40*s*. a quarter, a figure that appeared fabulous to the growers of barley in the eastern counties, where prices ranged from 22*s*. to 34*s*. Upon many farms the price of barley had averaged from 42*s*. to 44*s*. per quarter for many years, proving the prime quality of the grain produced. Oats are a favourite corn crop, but this year they are the worst cereal grown. Peas and beans are going out of fashion, but potatoes are somewhat extensively grown, and nothing could exceed their luxuriant and healthy appearance this summer. Coming as we did from different parts of the kingdom, it struck us that Derbyshire was favoured with a singularly good season, and that the weather was more propitious there than elsewhere. The great heat was always followed by copious rains, and the pastures, which were burnt up in some localities, always had a green hue and afforded a nice sweet bite for the cattle all through the year.

Insect life was very active this spring, despite the severity of the winter. A tiresome tiny maggot attacked the stem of the oats soon after it was above ground, and penetrating its inner case, cut off the shoot which should have produced the ear. The plant for a time looked dead, but subsequently made an effort to recover itself, and put forth a number of minute, faint stems, many of which produced a diminutive ear. The result of the attacks of this insect had a most damaging effect upon the oat-crop, and helped to give it that ragged appearance which was so common this year, but which was especially noticeable upon the first-prize farm. We noticed the ravages of this tiresome insect some five or six years ago, but it was not until this season that its depredations have been so extensive. About twenty years ago attention was first called to that comparatively new pest, the mangold-wurzel fly (*Anthomyia betæ*). In some localities its visits have been more or less frequent ever since, but last year it spread over a much larger area, and in both 1880 and 1881 many acres had to be ploughed up because of its destructive habits. The fly has two wings, is ashy grey with darker markings and black bristly hairs, and is quite half an inch across the spread of its wings. It makes its first appearance from March to May, but there are two broods in general, and in this dry year more than two. The eggs are white, and a microscope

shows them to be marked with a honeycomb pattern; they are laid on the under side of the leaves in small patches. When these hatch, the maggot bores into the leaf and feeds on the tissue that lies between the upper and under skin; it is a voracious feeder and may be seen turning from side to side like a cow grazing, and collecting its food with two black hooks with which its retractile head is furnished. The leaf then withers and looks as if it had been frostbitten, and unless there is sufficient force in the land to carry the plant through the crisis—which generally is the three or four weeks in which the first brood of maggots are feeding—the crop may be destroyed. Stimulating manures as guano, nitrate of soda, soot, and mineral phosphate have been used with good effect; phosphate is said to be best.

When the plant is sharply attacked in the early stage of its growth it has a hard struggle for life. It is seldom that a crop is entirely destroyed, but the depredations of the mangold-wurzel fly must militate against the extended cultivation of this most useful root. It has been the fashion of late to grow those varieties which produce but little top; but it will be a question if those kinds which send forth a vigorous growth of big leaves will not be better able to resist the attacks of this new pest. The old enemy of the turnip—the fly or beetle—has been as busy as ever. Notwithstanding the constant and most vigorous efforts of some of the competitors, it nearly destroyed some crops, and in all retarded their growth and spoiled the uniformity of the plant. All sorts of old-fashioned remedies were tried, rolling, brushing with elder boughs, and liming the plant. These operations were in one instance commenced as early as 3 A.M. and as late as 10 at night, and a fair plant was thus saved. Nowhere did we hear of the precaution of *steeping* the seed in paraffin, which is said to prevent or mitigate the attacks of the turnip-fly; but care should be taken not to steep it too long, as instances are recorded in which the germination of the seed has been injured or entirely destroyed. Besides the pests we have named, the wire-worm, the grub, and other insects seem to have done their full share of mischief this year.

The extent of turnips grown is not so great as in many localities. The cultivation of mangolds seems to be extending, and as that root produces plenty of milk, and will keep late in the spring, it is greatly valued, now that selling milk rather than producing butter is so much in vogue. But cabbages seem the most popular provender, and their more extended growth has become very general. We were told that they were especially useful for producing milk in "the fore part of the back end"—which portion of the year may be better known in other localities

as the early autumn—when cabbages supplement the failing grass, and are continued to be used with much success long after the cows have taken up their winter-quarters in the homestead. They are then sliced or pulped and mixed with grains, chop (chaff), and other dry provender. The weight of cabbages per acre was immense, especially in the one instance in which they were grown with liquid manure, in addition to a tremendous dressing of solid manures.

Although the proportion of the arable land to the pasture is small, yet a considerable extent of the grass-seeds upon the ploughed ground remains down more than one year. It seems singular that in other parts of the kingdom, where the rainfall is quite as heavy as at Derby, the four-course system of cropping should still be as religiously observed as it was in the days of dear corn and cheap labour. Now that corn-growing does not pay, and it is absolutely necessary, if some lands are to remain under the plough, to diminish their expenses, it is surely undesirable to always plough up ley ground after only one year's rest. The second year's grass may not be so prolific as the first, but there is no expense for seed, labour, or tillage, and the complaint that two years' seeds foul the land was disproved by the cleanly condition of the farms we inspected, where grass-seeds were commonly kept down two and sometimes three years. The corn crops which were grown upon the old seeds after one ploughing, whether wheat, barley, oats, or beans, were all alike good, the barley being especially grand; some after a three years' ley being the best crops we have seen grown in any district or in any season. The mixture of seeds used upon the various farms we inspected for these two and three years' seeds, will be found in a subsequent portion of this report. All that we need remark here, is, that alsyke clover and Timothy-grass often form a portion of these mixtures, and also of permanent grass-seeds, and that Timothy-grass, so commonly used by our grandfathers and which has been of late years almost driven out of our arable cultivation by different sorts of rye-grass, seems coming once more into general use.

There may be many other districts of England in which stiff arable lands are being rapidly, of late, converted into grass, but there are only a few in which there has been such a long and steady progress in that direction. The most successful instances of forming new pastures are to be seen at Croxden Abbey, where the late Mr. Carrington, and his father before him, converted a large extent of ploughed land into most valuable pasture. As this profitable creation of good grass-land has been duly recorded in the Society's Journal by the man who mainly carried out these improvements, we need not attempt to describe

them here, but we may remark that there appears to be no very general rule observed in laying down land to grass. One competitor (not a prize-taker) told us, in reply to an observation of the great difficulty in turning some land to good grass, "that he never saw the land he could not make lay." His process, perhaps, was not original, but was certainly inexpensive. Broad clover only was planted with the last crop (curiously enough in one instance it was sown with vetches), and then the land was for some years dressed with seeds from the hay-loft, and now and then manured. We fancy a great deal of the grass-land of the kingdom has been produced in this manner, for almost all the pastures of the Midlands were once under the plough. And it struck us that the pastures recently formed by sowing carefully selected seed have already made a sweeter turf than some of the old grass-land. They do not yet possess the strength or produce the bulk of the older meadows, but there is the absence of black couch and other coarse herbage that is often seen in really good old grass-land.

The treatment young pastures receive is also not very uniform. All agree that liberal manurings and dressings of compost are essential to new grass-land, but there appears also a very general concensus of opinion that grazing stock with decorticated cotton-cake is one of the cheapest and easiest modes of improving new pastures. It is to the liberal use of this most valuable artificial food that the late tenant of Croxden Abbey attributed the great and speedy improvement of his new pastures. It appeared to us somewhat singular that all the young stock we saw upon those farms, which had to graze on the fields during the winter, Mr. Carrington invariably fed himself, by throwing the cake, broken into lumps, and the dust removed, upon the ground. He carried the cake in two saddle-bags upon his pony, and this practical man of business contended that there was little or no waste, that every animal could secure its proper portion, and that there was no treading up the grass around tubs or bins, which is sure to result in wet weather unless they are constantly moved. The excellent condition in which these well-bred cattle were wintered, without shed or yard to shelter them, reminded us of the manner in which pedigree Shorthorns are treated in America.

The *rents* of the different farms we inspected appeared to us high, but not excessive, in favourable seasons, when their situation and advantages were considered. We were glad to find a rebate of about 10 per cent. was generally made to enable the tenants to tide over these bad times, but in no case did we hear of any permanent reduction of rents being made. Upon one farm we learnt that, in addition to the usual percentage,

a further reduction of rent was made on account of the disastrous floods; but we venture to express an opinion that 50*s.* an acre for a large farm whose meadows are subject to repeated floods, and whose arable land will burn in a dry season, and which has the worst buildings of any farm we inspected, requires either the expenditure of a large sum by the landlord, or a permanent drop in the rental to enable the enterprising tenant to make a fair living profit. The local burdens paid by the tenantry of the district are not very high; the poor's-rate appeared to us most creditably low.

Some sort of tenant-right appears to prevail in the neighbourhood, but it varies with the localities; and though it is being gradually strengthened and enlarged, it is neither so precise nor so ample as it ought to be. We have rarely visited any district in which the tenants contributed so much—sometimes the labour, sometimes a part of the materials—for the new buildings on the homesteads. In a few instances the whole cost of the cowhouse and other such necessary buildings has fallen entirely upon the yearly tenant. The late tenant of the Croxden Abbey farms spent his money on the permanent improvement of the land as if he had been the owner. Arable land was turned to pasture, and pipe-drainage 4 feet deep was executed without any aid from the landlord until last year, when the owner undertook some under-draining, charging the tenant a percentage upon the outlay. We well remember with what pride poor Mr. Carrington showed us his farms, as the good result of a complete confidence between landlord and tenant. He said he farmed without any agreement, and that his ancestors had been tenants of the land as long as the present noble family had owned it. Little did we dream, when we first inspected these farms, that a tenancy which had endured for centuries would be so sadly and suddenly terminated in a very few days. An attack of measles, bronchitis supervening, laid that strong, vigorous, and energetic man in his grave at the early age of forty. There was a young family, but no son old enough to succeed him. Not only was the head of the family taken away, but the hand that managed every detail of the farm was gone too, and no one could possibly fill his place. The dying man knew this, and directed his executors to at once relinquish all his farms. A heavy and complicated responsibility rests upon them. They must leave a large share of the tenant's capital in the land, and there being no general law by which compensation is secured to the old tenant, chief part of the tenant-right must be left to the justice and generosity of the landlord. We sincerely trust that an amicable settlement

may be arrived at, and that those splendid new pastures may not be ploughed up as the executors' last resource.

The farms that we inspected, and the district generally, seemed free from the ravages of game. Upon all farms there was some ground game, which is invariably reserved by the landlord, and in a few fields of oats and wheat hares had cut off large handfuls of ears to make their paths and play-places. In thin corns, which are common this year, the pastime of these interesting but most destructive animals soon takes off a bushel an acre from the yield, and they are yet more troublesome in a dry season among the mangold plants. Upon one farm we saw evidence that previously a large head of rabbits had been preserved, for the banks and fences had been seriously injured, although otherwise singularly neatly kept. Happily they had been killed down within very reasonable limits; but whether from a sense of the injustice of annoying and injuring an exceptionally good tenant, the influence our Report would have, or the dread of the Ground Game Act, we could not determine. That Act seems to have made but little difference in the relations of landlord and tenant upon all farms where only a moderate amount of game is kept. The tenants we visited were all determined not to interfere in any way with the reasonable sport of the owner, but there seemed a general impression that the result of the Act would be "to make the landlords trust their tenants more, and their gamekeepers less;" and if no other good results from it, that will be no inconsiderable gain to the farmers of England.

The *wet seasons* have terribly injured almost all the grass-land we inspected. One serious evil was the prevalence of rot among the sheep, which had not only diminished the numbers kept, but some farmers had resolved never to have another sheep upon their land. The damage from rot was not only upon the flooded meadows, it extended to many commonly dry pastures. Upon such soils the character of the herbage had been entirely changed by the long prevalence of wet weather. The finer grasses had disappeared, and the coarser sub-aquatic grasses had taken their place, and "hassocks" appeared in fields that never before produced them. In the furrows and low spots of some meadows they had taken entire possession of the land. The cost of the removal of these "hassocks" will be a great expense to the tenant for many years to come.

But the fear of a continuance of the rot upon unflooded pastures appears to us unfounded. After a roasting summer like this, the insect which has slain its thousands must perish from lack of moisture; and we hope that the stock of sheep around Derby, which has so seriously diminished within the past two years, will be soon restored to their previous numbers. Yet the serious

question of preventing a return of the malady does not seem to be solved. No human precaution could possibly provide against a return of wet seasons; and when pasture-lands shall be again sodden for years, fluke-rot will be prevalent, do what we may. But the state of every river and almost every stream upon the farms we visited, shows how fearfully arterial drainage has been neglected. The whole valley of the Trent, with the valleys of its numerous tributaries, seems hardly capable of holding a twenty-four hours' rainfall. The Trent itself is in a fearful state. Shoals exist in the bed of the river to such an extent as to force the whole current of the stream into new channels, while every turn seems to become more crooked, and every angle more acute. Not only is no effort made to remove these natural impediments to the rapid flow of the water, but many obstacles seem purposely or ignorantly placed in the river to resist or impede its progress. No wonder then that floods in wet seasons are common, and that thousands of acres of the broad and fertile valley of the Trent have been well-nigh ruined by the continual overflow of the river. Fourteen floods from July 1880 to February in this year, are enough to break any tenant of a Trent meadow. Not that all floods are injurious: winter floods that do not remain too long upon the land are beneficial; but in the summer, when the hay is washed away, the aftermath silted and spoiled, and the whole valley one vast quagmire, these floods are most disastrous. Only in the valley of the Dove did we see any effort to prevent a recurrence of these evils, and there the river was being embanked for miles. Legislation appears necessary before any grand scheme of "flood prevention" can become general; but we found a perfect unanimity of opinion against the measure introduced this year to Parliament. It was unanimously condemned, and the suffering tenants all say that they would rather have no legislation then that such a bill should become law. The idea of taxing the uplands finds universal disfavour, and it is firmly contended that underdraining has not contributed to the recent floods. The arable lands we inspected were mostly drained for the removal of the surface-water. Previously the excess of rain which fell upon these clay soils ran off the surface, but when properly drained the water should percolate through 3 or 4 feet of soil before it finds its way into the ditches. And there is not only this large amount of soil to filter through, but a greater quantity of moisture is held in the subsoil by suspension. No doubt of late years the best-drained heavy lands have been so constantly sodden as to have lost their porosity, and the rainfall has run directly off the surface; but that has only reduced the ground to the condition it was in before it was

drained. If any legislation for the prevention of floods is to be successful, the great injustice of taxing uplands for the benefit of the valleys, or of fining those low-lying localities which have effectually drained their districts, must be omitted from the scheme.

A great extent of land in the district we visited is being underdrained, and much is being redrained. Save on the Croxden Abbey farms, where the landlord and the late tenant both held to the uniform depth of 4 feet, much shallower draining is now general. And we must report that the four-feet drainage upon the clay pastures of Nothill was by no means a success. The drains are usually 10 yards apart. The herbage in the immediate vicinity of the drains was no doubt much improved, but farther from the drains it became coarser, until in the centre of the intervals which separated them, rushes very often appeared. It was stated to us that upon some very stiff clays all pipe-draining was a mistake, and that unless supplemented with a few stones upon the top of the pipe, a perfect cure could not be effected. Two-inch pipes appear to be abandoned in favour of three-inch, thus showing the folly of those who advocated the sufficiency of one-inch pipes—pencil-cases as they were called;—and main drains are now filled with four- and even six-inch pipes. The space between the drains is narrowed, 6 or 7 yards being considered the outside distance if thorough draining is to be secured. The depth is no longer 4 feet; but 3 feet, $2\frac{1}{2}$, and even 2 feet are now advocated. Neither is there that general system of running all drains directly up and down the incline of the land; but the old plan of placing the drain in the furrows of high-backed lands is still found to answer best. Without wishing to endorse all the opinions we have just recorded, we unhesitatingly express our conviction that the minimum depth of 4 feet, which was at one period generally insisted upon by Government inspectors, draining companies, and some great land-agents, is a decided mistake, and that it pays much better in draining heavy land to reduce the depth and augment the number of the drains. This remark does not apply to subsoil water or springs; for in such cases no doubt a few deep drains will often do more good than a multiplicity of shallow ones.

In confirmation of what we have stated, we insert the following remarks of Mr. Arthur Milner, the winner of the first prize in the small dairy farm class, whose opinion, as a sound practical farmer and a man of careful observation, will command attention:—

"Some years ago draining was a subject which was discussed a great deal by the leading agriculturists of the country at the various agricultural meetings. Since that time there have been ample opportunities to experiment on the various systems

advocated and to prove the results. Different depths and distances apart have been tried, and also the material used has been differently employed. Many were of opinion that it was not the surface-water that damaged the land, but the deeper water, and those were in favour of deeper draining, so as to reach the lower strata; and then it was not needed to have the drains so near together as in the case of shallow draining. Four and 5 feet deep and 12 yards apart was considered by them to be the best system. Others thought that this mode could not possibly answer on some land, as they had proved by experience that drains, no matter how deep, would not dry the land effectually at so great a distance. Practical engineers stated that in making deep cuttings in railways they found that the land was only benefited to a very limited distance by them. It was thought also by many that it was of the first importance to cut the drains as much as possible so as to cross the meadows, and thereby receive the greater amount of water, irrespective of the inclination of the land. These various opinions caused some warmth of feeling to exist between landlord and tenant in respect to draining. The practical tenant generally was in favour of not having the drains more than 6 yards apart, whilst the landlord was impressed with the advantages of the theoretical principle laid down by the Government plan, and insisted upon deeper draining and greater distance apart. It is the custom in many instances for the landlord to find drain-pipes and the tenant to find labour, and in this case the greater distance the drains are apart the less the expense to the landlord. In some fields there are two kinds of draining done at this time, some 30 inches to 1 yard deep, and 6 yards between the drains, and the other 4 feet deep and 8 yards apart. Also there are in other fields draining done 30 inches deep and 6 yards apart on one half of the field, the drains extending in the same direction as the furrows, whilst the other half of the field is drained 5 feet deep and 12 yards distant across the furrows and the measures. This draining was done twenty to thirty years since, and in each of the fields named the deeper draining has proved a failure. The deeper draining is at this time quite worthless, and never acted effectually, whilst that 30 inches deep and 6 yards between was satisfactory. Where the land was drained twenty to thirty years since 5 and 6 feet deep and 12 yards apart, the drains extending across the measures, it is now covered with rushes; the other half of the same field drained 6 yards apart being in much a better state. In the most effectually drained half of the field, the drains extend in the same direction as the furrows, and thereby obtain the better fall. In most of the instances named two-inch pipes were

used, a single stone being placed over the joints of the pipes, the clay put in first, and the soil in its original position. But there is a considerable area of land which was drained 6 yards apart and 30 inches deep twenty years ago, and that now requires redraining. It would seem a question quite as important to consider what material is best to use in draining, and the manner in which it should be employed, as to discuss the best course to be adopted in regard to depth and distance apart. The draining adopted by the Government system, of 5 and 6 feet deep, to 10 and 12 yards apart, with pipes alone, the clay pounded upon the pipes, is proved by experience to be in many instances, if not all, a failure. No better proof is needed of the uselessness of putting the drains too far apart, no matter what depth, than the state of wet land by the deep cuttings of railways. Where cuttings of 10 yards, or more, extend through wet land, it is not dried more than 3 or 4 yards from the edge of the embankment. Drains, therefore, are best not more than 6 yards apart, no matter what depth they are made. The next question to be considered is, what material is best to be used in draining? Pipes alone, pipes and stone, stone alone, and in some rare instances turf, has been used severally as material for draining. Even brushwood has been used alone, and has acted quite well for a time. Draining with pipes alone at various depths and distances has proved ineffectual from various causes. Never at any time did draining with pipes alone equal that done with pipes and stone combined. Frequently have drains been stopped up in a few years when only pipes have been used, and never do they last the same as when a portion of stone has been put upon the pipes. Pipes have been stopped up in a few years after being laid, from the following causes: from a fibrous-looking substance resembling heckled flax, which proved to be a water-grass root, or alga, fed on water and showing no top, also from the roots of mangold wurtzel; further, it has been known that where manure-heaps have been made over drains, the pipes have become choked up by a fungus produced from the manure heap. No such cases have been known to occur where a layer of stone has been put over the pipe. If the pipe became stopped up from any cause, when there are a few inches of stone over the pipe the water can escape over the pipe. It would appear that stone without pipe is preferable to pipe without stone. For much draining was done with stone alone forty to fifty years ago on grass-land that to all appearance is as perfect and acts as well now as when done. This is not the case where pipes alone have been used, but it often happens that land so drained in ten to twenty years requires redraining, and before that time in very wet seasons such draining seems to

have but little effect. Fields adjoining each other that were drained thirty years ago, the one with pipes alone, and the other with pipes and stone—the former is now covered with rushes and wants redraining, whilst the latter is as perfect as when first done. Each of the last fields alluded to have the same inclination, the same class of soil, and the same class of draining, viz. 30 inches deep and 6 yards apart. A few years ago a leading agriculturist experimented in one field with two kinds of draining. One half of the field was drained 5 to 6 feet deep with pipes, the other half 30 inches with stone filled nearly to the top. The deeper draining was cut further apart and also across the measures. The result of this experiment was that the drains filled with stone made the land all that could be desired; the deep draining was a complete failure. In some instances drains have been made with pipes and stone, 30 inches deep and 8 yards between the drains. This has been found too wide, and an extra drain cut between, making it 4 yards apart, has rendered the draining complete. From these observations it would appear that the best and most effectual mode of draining is 30 to 36 inches deep, 6 yards apart, with two- to three-inch pipes, and about 3 or 4 inches of stone over the pipe, a little straw or brushwood over the stone, the clay put in first, the soil on the top."

As an illustration of how farm customs change we may notice that the fixed threshing machine which the tenant of the first-prize farm put up less than twenty years ago is now seldom used. It is found cheaper to hire a portable engine and machine and thresh the stacks where they stand, rather than remove them to the barn, although the stack-yard joins it. Upon the second-prize farm is a capital fixed chaff-cutter, but it is considered more economical to chaff up the straw at the same time that it is thrashed in the field, and to remove the chaff in large bags direct to the buildings, where it is safely stored until it is wanted for the cattle.

It would be ungracious for us to close this report without tendering to "each and every" candidate our best thanks for constant courtesies and unbounded hospitality. Had we made what might have been considered the best of our opportunities, our digestive organs would have been strained to the uttermost. To have a jolly breakfast at 7.30, and to be expected to be in a position to enjoy a good hot dinner soon after 11, was beyond our power, but otherwise we did not fail to do ample justice to the good cheer so bountifully supplied at all hours of the day. Not only were our creature comforts provided for, but all our queries, some of the most searching and inquisitorial character, were answered with promptness, openness, and cordiality, and every scrap of information, whether it told for or against the

farm, was readily forthcoming. We left the neighbourhood with an impression that it would be hard to find in England a more thoroughly practical, industrious, careful, and keen set of tenants than the competitors for the Derbyshire farm prizes in 1881.

We would suggest, that if similar prizes are offered for farms in connection with the annual show of the Royal Agricultural Society, that the request now made for the Judges' award to be given in time to be read out at the members' meeting, should not be repeated. Three visits are necessary for the Judges to arrive at their ultimate decision. The first inspection should be made in the winter, and it is no use going again until the spring corn is sown and the roots are being planted. In a backward spring like the last, it was not possible to begin a second visit until quite the end of May, and as the final inspection had to be made before the Royal Show, an interval of only five weeks elapsed between our second and third visits, and it was too early to see how the corn ripened, and how the cereal year was likely to end. If the last visit were paid a week after instead of a week before the Royal Show, it would enable the Judges to make more accurate awards, and by giving them time during the autumn to prepare their report, might produce something more worthy of the 'Journal' than these hastily-written notes, strung together at the end of haysel and the early days of harvest, can possibly hope to be.

The following is a copy of our award:—

The majority of the Judges of the competing farms award the *First Prize*, in Class 1 (large dairy farms), to George Bryer, of Markeaton Park; and the *Second Prize* to John Hellaby, of Twyford.

The Judges unanimously recommend a *Third Prize* of 25*l.* to Arthur Stretton, of Wichnor Bridges, and suggest that as they withhold the second prize of a similar amount in the next class, such prize should be made a third prize in this class.

The Judges award a special high commendation to the farms of the late W. T. Carrington, of Croxden Abbey, for the excellence of the stock, the cultivation, condition, and general management of the land, and the large and successful outlay of tenant's capital in the permanent improvement of the farms; and they deeply regret that the sudden and lamented death of that distinguished agriculturist deprived them of that information which might have enabled them to place his farms in the prize list.

The Judges highly commend the farms occupied by Richard Finney, of Hemington.

In Class 2 (small dairy farms) they unanimously award the *First Prize* to Arthur Milner, of Stretton.

They withhold the *Second Prize* in this Class.

In Class 3 (arable or mixed farms) they unanimously award the *First Prize* to Francis Allen Price, of Bainsheath, and the *Second Prize* to Edward George Rossell, of Stapleford.

(Signed) W. P. J. Allsebrook.
George Gibbons.
Clare Sewell Read.

Mr. George Bryer, Markeaton Park, near Derby.

First-Prize Large Dairy Farm.—Class I.

Mr. Bryer's farm is just the place for a milk trade, and he has made the trade to the place. Success often or mostly depends on the skill and discernment with which a business is made to suit its locality and surroundings; this is especially true in respect to farming. Markeaton Park is two miles from Derby by a good road, and can scarcely lie better for supplying milk direct to Derby consumers.

The whole of the land in the occupation of Mr. Bryer is 250 acres. The home farm, the property of F. Noel Mundy, Esq., of Markeaton Hall, is 186 acres, 35 of which are arable. Another homestead, with 30 acres of grass-land, belongs to Capt. Evans, Derby; and 34 acres, also grass, are owned by Walter Evans, Esq., of Darley Abbey. It will be seen that Mr. Bryer has but a small part of his farm under the plough, but he thinks it quite enough. It is all strong red marl land of the New Red Sandstone formation, is not liable to burn, grows an excellent quality of grass, and is just the sort of land to retain manure.

Two cottages are held with the farm, besides the house at Mile Ash; the cottages are occupied by the labourers.

Mr. Bryer's family has held the Markeaton Park Farm for a hundred years at least. The present occupier followed his father as tenant in 1854 at an advanced rent of 60*l.* a year. He is not under the Agricultural Holdings Act, but is a yearly tenant, and under his agreement would receive compensation for the unexhausted value of the linseed and cotton-cake and corn used on the farm during the two previous years. A good substantial house, built for the present tenant, stands with the back to a yard and front to a lawn, beyond which is the kitchen garden. The other three sides of the yard, which is flagged, are occupied by some very good buildings. A good six-horse-power fixed steam engine, by Abell, Derby, drives chaff-cutter, threshing-machine, pulper, corn-mill (3 ft. 6 in. French stones), and two cake-crushers.

The cut chaff falls into a large cistern, and is steamed; the steaming renders damaged hay palatable, obviates any danger from dust, and kills the seeds of all weeds that might be in the fodder. The chaff cistern opens into a mixing-house, and so do some large grain cisterns. On the same floor is a large iron boiler, in which meal, &c., can be cooked by steam. All the machinery is under the care of one of Mr. Bryer's sons when Mr. Bryer himself is not attending to it, and it is a great credit

to him, kept clean and trim, with the tools in their places ready for use. Next to the mixing-floor is a very-well-built cowshed, with a gangway before the cows, and recesses in the walls for hay. From the gangway we pass into a root-house, and at right angles on another side of the yard is a double cowshed, with a gangway between the rows of cows' heads. The sheds are clean, whitewashed, and well ventilated. The troughs are of brick, and the sills of oak. Altogether, there are standings for 56 cows and 6 horses, besides standings for 30 cows and 2 horses at Mile Ash. By the stackyard are two other yards, with shedding round them. In these yards last December were 10 capital bullocks, 4 of them worth 34*l.* or 35*l.* apiece. Here in May and July a young pedigree bull chewed his cud. He was bred by T. G. Attwater, Esq., and bought at Bingley Hall spring sale for 62 guineas.

Adjoining the yard slast mentioned is a large liquid-manure tank, which measures internally 1500 cubic feet. All the drainage from the cowsheds, yards, and the whole premises is collected here, and by gravitation is carried through pipes into a meadow below, where it is distributed from hydrants through fifty yards of canvas hose over the grass; and very well it has answered. This year more iron pipes and three hydrants have been fixed in a field of arable land, 5½ acres. This has been done since our December inspection, and with excellent results. At that time the field looked as rough as possible—a wheat stubble that had been steam cultivated. In the winter 25 tons per acre of dung were put on and in January ploughed in 6 inches deep. In the spring this was worked down and ridged; Drumhead cabbages were planted in April on 3½ acres; in May a good drenching from the tank was applied, and on July 7th many a cabbage covered the square yard allotted to it. The soil had been moulded up to the plants in June, and all looked very nice and clean.

Crops this year are—

Wheat	6	acres.
Barley	4	,,
Oats	12	,,
Mangolds	4½	,,
Swedes	1½	,,
Cabbage	4½	,,
Hay	56	,,

Wheat.—Six acres of wheat after oats are a fine crop, taller by half a yard than the neat quick-fence; a fair plant and well headed. These ears resemble drumsticks as much as many ears last year resembled feathers. Lime was applied, and 2 bushels

per acre of red wheat were sown early. It looks like 6 quarters per acre. We never saw a field so full of wheat; the corners are planted, and it grows so close to the hedges that in a wind some of it seems to get into the next field.

Barley after oats is a prime crop, but not so good after cabbage: cabbage is a hungry plant, and takes much out of the land.

Oats.—Like many other farmers this year, Mr. Bryer has a disappointment in his oat crop. Much of the piece—12 acres—has been spoiled by a maggot eating away the leading shoot about the beginning of May, and in July bunches of green, late, stunted stems threatened to be so much behind the uninjured ones at harvest that a smaller yield would be the result. This disease is common this year, and few crops of oats over a large district have escaped; indeed, through the dryness of the season, all kinds of insects and other pests have prospered and increased to an unusual extent.

Roots.—Two acres of mangolds are by the cabbage, and $2\frac{1}{2}$ acres in the next field by an acre more of cabbage, $1\frac{1}{2}$ acre swedes, and a few very vigorous potatoes. This land is not suited to the growth of potatoes, so only a few for home use are grown; but potatoes, mangolds, and swedes are all managed as well as market-garden crops, and are a pattern worthy of any farmer's imitation. For mangolds next the big cabbages the land was manured, and treated the same as for cabbages; but, as it could not have liquid manure, 4 cwts. per acre of Webb's mangold manure was applied. Mr. Bryer will receive as first farm-prize winner from Messrs. Webb 15*l.* 15*s.*, because Mr. Bryer has had seed from that firm. The mangolds were sown on ridges 24 inches apart, and were an excellent plant: 6 lbs. per acre were sown April 11th.

Mangold Fly.—All the mangolds, like most in the Midland Counties, have suffered greatly from the ravages of the larvæ of the mangold fly (*Anthomyia betæ*). In Mr. Bryer's fields, and in others, we have noticed flocks of little birds, mostly sparrows and chaffinches, that were feeding on the insects. So well had they done their work at Markeaton Park that we had some difficulty in finding a maggot in the leaves; the vesicle had been torn open, and the maggot removed, let us hope, into safe custody. If we are to be visited with this pest, a variety of mangolds with vigorous tops would appear to be most suitable.

Hay.—Clover is not grown every year, but about 56 acres of meadow-land are usually cut for hay. The crops were much better than most hay crops this year, but not up to the usual average. At the time of our latest inspection, the second field was partly secured, all so far in excellent condition, and part of another was cut; all the mowing was done beautifully by a good machine and a careful driver, Mr. Bryer's eldest son.

Grass-land.—This is the larger and more important part of the farm, and, we should say, the best and most profitable; though, for the sake of the roots and litter it grows, it would be inconvenient to be without arable land. We have never seen a lot of grass-land better managed. Whether attention was directed to the draining of the land, the freedom from thistles, docks, nettles, or other weeds, the quality of the grass and herbage, the excellent repair of the fences, the scoured-out ditches, the condition of the well-painted gates and posts, the carefully made waterings, or the gravelled gateways,—all alike showed the constant attention of a thoughtful and capable manager. Some years since 18 acres of arable land were laid down to grass; it has been so liberally manured and judiciously treated that it is sweeter and earlier in spring, and is in fact better, than older turf.

Water.—This is an important consideration on any farm, and especially so when many cattle are kept, and this importance is still more emphasised if there is a large dairy. Indeed, the high repute in which Derbyshire milk is held in London (the Midland Railway Company alone carry $5\frac{1}{2}$ million gallons a year) is said to be attributable to the special purity of the water which the cows drink from the clear streams that abound in this land of hills and dales. A little brook runs through several grass-fields, and in the course of this Mr. Bryer has made four waterings by damming up the stream, making an inclined approach, and, in one recently made, pitching the floor with sandstone; so that even this dry summer the supply has not failed, and he has not had to do, as he did ten years since, drive his cattle twice daily to a brook some distance away; but then the water of the little brook was wasted by meandering about some muddy fish-ponds in the upper field on the stream. Now these are drained and grow good grass. To make assurance doubly sure, Mr. Bryer is in treaty with the Derby Waterworks to bring their water from his upper homestead (Mile Ash) to the Park Farm, and he intends to erect a milk-house, to be fitted with Lawrence's refrigerator, and conveniences to wash and scald the cans and churns, and to load the milk into the carts.

Cattle.—The number on the farm were in

December.	*May.*	*July.*
2 Bulls.	2 Bulls.	2 Bulls.
63 Cows in milk.	55 Cows in milk.	58 Cows in milk.
10 Steers.	30 Feeding cattle.	21 Feeding cattle.
15 Heifers.	10 Heifers.	8 Heifers.
5 Yearlings.	15 Calves.	13 Calves.
10 Calves.		4 In-calvers.
105	112	106

Dairy Cows.—The number of cows in milk varies just according to the demand for milk in Derby; for there it is retailed. From 50 to 60 capital specimens of Derbyshire Shorthorns are usually kept. About 18 of these are annually bought, and some are reared and brought into the dairy; about 25 are annually drafted out, fatted, and sold to the butcher. All the milk is retailed in Derby, except, perhaps, a small quantity just in the flush of the season, when a little butter is made, and some calves are reared or fattened. Two milk-carts attended by two men and two boys take the milk and deliver it twice a day to 204 customers. The carts, with churns holding from 16 to 18 gallons, leave at 7 A.M., returning at 11·30 A.M.; and at 5.30 P.M., returning at 8 P.M. It is distributed at the doors of the customers in quantities as small as 1*d.* worth. The price obtained for milk is on the average 1*s.* per gallon, and it costs 2*d.* per gallon for delivery. The quantities and receipts for milk for four years are given below:—

	1877.	£		1878.	£
Gallons ..	48,229	2381	Gallons ..	49,549	2481
	1879.			1880.	
„ ..	45,912	2211	„ ..	45,416	2131

Milk has been purchased to retain customers, and the sums paid in the four years were—

	1877.	£		1878.	£
Gallons ..	3,191	131	Gallons ..	6,363	248
	1879.			1880.	
„ ..	7,462	265	„ ..	6,342	217

In the summer, only deep milkers get artificial food, but in winter all have abundance of rich food; then each cow in full milk gets daily 6 lbs. of meal ($\frac{2}{3}$ Indian corn, and $\frac{1}{3}$ beans, peas, or oats), 3 pecks grains, 20 lbs. roots (or, if roots are scarce, 2 lbs. bran), with inferior hay cut into chaff and steamed. If the hay is good one-third oat-straw is chopped up with it. A feed of best long hay is given the first thing in the morning, and the last at night. Any cow that loses a quarter, or fails to give satisfaction as a milker, is treated to 5 lbs. of linseed-cake till the butcher has her.

Calves are taken right away from the dam and fed by hand, most are sold within a week at about 24*s.* a head. Those that are reared have new milk for a week, then skimmed milk, calf-meal, ground oil-cake, and maize-meal, until they are 3 months old, then corn, cake, pulped roots, and cut-chaff, till they go out to grass, when artificial food ceases. Mr. Bryer has not

reared many, but he has unfortunately brought disease to the farm with some he has bought. For instance, last spring he bought from a dealer in Derby eight stirks that had come from Penistone, Yorkshire; two of these had been purchased by the dealer from a man who had foot-and-mouth disease among his cattle, and they came in a truck with the six. Foot-and-mouth disease broke out among them in a day or two. By careful isolation the spread of the disease was prevented, though the sick animals remained in the field where the disease was discovered, within 100 yards of the homestead where the dairy cattle were. Now that Mr. Bryer has taken more grass-land and bought the pedigree bull he intends rearing more calves.

Feeding Cattle.—Besides the 25 draft cows from the dairy, about 30 heifers and young cows are annually purchased, grazed in the summer, and, if any are not finished, brought into sheds for that purpose. The receipts for fat stock in the four past years were:—1877, 1256*l.*; 1878, 1237*l.*; 1879, 1436*l.*; 1880, 1262*l.*

Sheep.—The sheep are Leicesters and Shropshires; there were 67 in December, 104 in May, and 89 in July, and some lambs had been sold fat. Sheep here are a secondary consideration; they do not get the attention the cattle do, and we can imagine they may be in the way sometimes, though useful at others. Fleeces average 8 lbs. each.

Horses.—Four cart-horses are kept, from one of which a foal is expected each year, also two milk horses, and a nag.

Pigs.—As usual on milk-selling farms, pigs are a small stock. Four very nice little Berkshires were in the styes in May and July, but they were only for home use.

Labour.—Three labourers are employed at 18*s.* a week, one at 9*s.* and his board, one at 14*s.* and lodgings, a boy at 6*l.*, and another at 10*l.* a year with board and lodgings. The two milkmen have extra wages, and cannot be reckoned as farm hands. The milking is done by seven hands, assisted by Mr. Bryer and his son. But little piece-work is done. The price for cutting hedges is 9*d.* per rood (8 yards), and for cutting off roots 12*s.* to 14*s.* per acre. A pint of beer daily, at 6*d.* per gallon, is allowed always, and extra beer and ale in harvest. Very few farmers or labourers brew; nearly all buy from the breweries. The beer bills belong entirely to the labour account, for Mr. Bryer and all his numerous family are total abstainers; the children have been all their lives, and Mr. Bryer longer than they. The average cost of labour for four years has been 387*l.* per annum, or 31*s.* per acre.

Purchased Feeding Stuffs and Manure.—The quantity of linseed-cake consumed in 1880 was 15 tons 17½ cwts.; of maize,

166 qrs.; beans, 43 qrs.; maize-meal, 48 sacks; fine sharps, 37 sacks; bran, 5 tons 6 cwts.; and grains at 3*d.* to 6*d.* a bushel, 206*l.* 2*s.* 4*d.* (equal at 4½*d.* per bushel to 11,000 bushels).

Total cost of feeding-stuffs:—1877, 684*l.*; 1878, 774*l.*; 1879, 670*l.*; 1880, 817*l.*; amounting to an average cost per acre for food and manure to the large sum of 63*s.* 5*d.* over the whole 250 acres.

Accounts.—No particular system of accounts is used, but a careful entry is made daily of all receipts and expenditure, and the books are regularly made up each half-year. Miss Mary Bryer seems to be her father's chief clerk, a very useful and honourable position.

Orchard.—Two acres of orchard are a pleasant and profitable addition to this farm, and this year there is a good crop of apples, pears, and damsons. The trees were planted entirely at Mr. Bryer's own expense. If landowners would plant fruit-trees more extensively where they thrive well, it would increase the value of their property and the prosperity of their tenants.

Improvements.—The tenant has here made many permanent improvements, and very many of the conveniences and advantages are the result of the expenditure of his skill, labour, and capital. Besides those things mentioned, the building of liquid-manure tanks, laying down the glazed and iron pipes, the former in cement; grubbing up about 1½ miles of old fences, replanting and renewing fences (the landlord finding one-third of quick and timber in the rough); Mr. Bryer has put in 40,000 drain pipes, from 3 to 4 feet deep, at his own cost, and made a good gravel road from the the turnpike-road to his house, the landlord allowing him to have 500 yards of gravel ready dug at 1*s.* 6*d.* per yard.

This farm is a splendid example of what may be done by plodding industry and long-continued judicious employment of capital. Few men could make such a place succeed so well, none without long experience; and unless complete confidence existed between landlord and tenant, a tenant would be foolish to risk his capital to such an extent. Happy is a tenant with such a landlord, and, we think, happier is a landlord with such a tenant.

Mr. John Hellaby's Farm, Twyford, Derby.

Second-Prize Large Dairy Farm.—Class I.

Six miles from Derby, and less than half that from Repton and Willington, stands Mr. Hellaby's pleasant homestead. A good substantial house, with a neat lawn in front, which is

flanked by well-kept and productive kitchen-garden quarters, looks over level turf fields and low quick-fences, down to the River Trent and beyond. A little corner of the field between the house and the road has been fenced off by Mr. Hellaby, planted with shrubs and evergreens, a pretty path left through it, and a wicket-gate to the public road. It is some years since this was done; the shrubs have grown up, and add much to the cosy and pleasant look of the farmhouse.

The Buildings are good and substantial, the more modern and convenient ones having been built by the present tenant. These improvements, especially the garden and shrubberies, are the sort of links that seem to bind and hold a tenant to a place —these must be broken through if he must go away.

Size of Farm.—Twyford Farm is 173 acres—53 arable and 120 grass. At Stenson, 1½ miles from Twyford, there are 125 acres. We will deal with Twyford Farm first.

Character.—It is all light land with Trent gravel as subsoil, and is the property of Sir J. H. Crewe, Calke Abbey, Derbyshire. One mile from the house, on the south side of the farm, is the Trent—last winter it came within half a mile. On its banks are Mr. Hellaby's best pasture fields, though they have suffered, like other grass land, and are not now worth so much as they were half a dozen years since. On the further side of the Trent are some high rocks with caves in them, which look as if they may have been the dwellings of the Troglodyte inhabitants of the Midlands when Nottingham caves were peopled. The farm is quite level, and when the Trent rises a few feet over its banks, half the farm, including much of the arable land, is covered. There are more trees on some of it than are good for fences or crops; they are mostly ash, oak, and elm; from this and other farms we saw, we infer that the owner has a liking, not exactly harmless, for trees about his farms.

Tenure.—Mr. Hellaby entered in 1868, and is a yearly tenant. His agreement would give to the outgoing tenant *4l.* per acre for all swedes and mangolds grown in the last year of the tenancy, and *3l.* per acre for turnips; for grains, one-fifth of the cost; for cake, meal, and purchased-corn, one-third of the cost and carriage, for all consumed in the last year; full value for manure left, seed and labour on all wheats and clovers sown.

Course of Cropping.—A six-course of cropping is usually followed, viz. oats, wheat, roots, barley, seeds, and second seeds.

Crops.—This year there are—

Mangolds, 8 acres, Carter's Warden, and Webb's Yellow Globe.
Swedes, 4 acres
Cabbage, 2 „

Potatoes,	$0\frac{1}{2}$	acres.	
Seeds,	16	„	
Oats,	$9\frac{3}{4}$	„	Polish.
Barley,	10	„	
Wheat,	$7\frac{1}{2}$	„	square head.

Roots.—Mangolds, swedes, cabbages, and potatoes, have been treated alike as to preparation. In December we saw pairs of good horses stepping along at a great pace, ploughing the last of the field, which had been well cleaned. In February this was manured and ploughed again.

Then the unruly Trent overflowed its banks in an unwonted manner and covered the field. The land was ridged in the spring, dung spread in the ridges, and they were split back, drilled 27 inches apart, and well rolled down. A few ridges were left unrolled, and we easily picked them out in May and in July. The mangolds were not nearly so good as where the ridges had been made more solid—the rolled ridges had retained the moisture better. Both swedes and mangolds are very good and promise to make great crops. Potatoes, like most this year, look well, and the cabbage was thriving in July, though a grub had done much mischief awhile before.

Seeds.—The "seeds" were tall and forward in May and all in stack in July—a capital stack of fodder, which Mr. Hellaby reckons at 50 cwt. per acre. On one part of the field, where the floods had been, there was little clover, but the Italian rye-grass was tall and thick; this Lolium and Alsyke clover will stand flooding; red clover will not. In the winter the seeds are grazed with sheep eating grains, roots, corn, and cake, so that when ploughed and sown with oats in spring, the land is in fine condition.

Barley.—The 10 acres of barley at Twyford, and that at Stenson too, were grand crops in July, and promised quite 6 qrs. to the acre.

Wheat.—The variety growing is Square Head, and a very nice level crop it is, the land being quite clean. This wheat seems to be grown in preference to other varieties in this district, and it deserves to be a favourite.

Hay.—Only $6\frac{1}{2}$ acres of meadow-hay is made, but a very good crop is nearly always secured, and this year is no exception. Of clover-hay but 16 acres are cut. Though this was a very good crop, and all secured in splendid condition, this small quantity of hay would never winter all the stock Mr. Hellaby keeps without considerable help. This is given by cutting up all the oat and some other straw, adding grains, meal, &c.

Grass-land.—As before hinted the Trent and wet seasons

have done mischief to the herbage and finer grasses, and rough-leaved grass and rushes try to grow in the furrows and low places. One field was laid down a few years since, and every year it has been top-dressed with manure or compost. The treatment seems to agree with it, for a good sward of fine grasses and white clover is the result.

Cattle.—The numbers were in—

December.	*May.*	*July.*
49 Cows in milk.	36 Cows in milk.	36 Cows in milk.
1 Bull.	2 Bulls.	2 Bulls.
8 Calves.	18 Feeding cattle.	15 Feeding cattle.
8 Heifers.	7 Heifers.	3 Dry cows.
	8 Yearlings.	7 Heifers.
	9 Calves.	8 Yearlings.
		9 Calves.
66	80	80

Dairy Cows.—Here is Mr. Hellaby's strongest point. We know not where to look for 36 such grand dairy cows as the Twyford herd. For size of frame, for quality and character, for meat and milk-producing properties all combined and in such perfection, they would be hard to beat. The owner says they have no pedigree, but we think that statement should be qualified. He and his father set before them an ideal dairy cow, for years they have striven to reach that ideal, and we now see the result. It is a home-made pedigree, doubtless, and not in the Herd-book, but still a very honourable one, and reflects the highest credit on the judgment and skill that have produced such a result.

In May, in one pasture, 55 acres, were 36 cows, giving 118 gallons of milk a-day, 40 sheep, and a horse or two. Much of Mr. Hellaby's land is full of stock like this, so he balances the account by giving to the cows food in the sheds when they come in to be milked. Each cow gets, daily, a peck of grains with 4 lbs. of meal, half rice and half maize. The milk is cooled in Lawrence's refrigerator, sent twice daily to Willington station, and thence to London (126 miles), the sender paying carriage, 2*d.* per barn gallon of 17 pints.

The price obtained per "barn" is:—In April, May, and June, 1*s.* 5*d.*; in July, August, and September, 1*s.* 6*d.*; in October and November, 1*s.* 9*d.*; December, January, February, and March, 1*s.* 10*d.*

The amount received for milk in 1879, was 1088*l.*, and in 1880, 1219*l.*

Mr. Hellaby lives up to his privileges in respect of his proximity to Burton and the brewers' grains. When we were at Twyford in December, he was using from a stock of 10,000 bushels; in July he was again filling up his cisterns. A barn has been converted into a convenient mixing-house. Over one

bay is a wooden chamber, in which can be stored all the chaff cut up in a day, and that would be all the straw threshed in a day, for one of Maynard's chaff-cutters is hired at 20*s.* a day, and cuts up the straw as fast as the machine threshes it. In the other bay is a large cistern, 6 or 8 feet deep, with dividing walls 5 feet high. Into this the grains are put and well trodden down. The pulper, Bentall's cylindrical, is on the old barn floor, and the horseworks to drive it outside; so here altogether is the food in the mixing-house. A door at the end of the bay, under the chaff-chamber, opens into the largest cowshed, and all the cows can be conveniently fed with but little labour or loss of time.

The winter food consists of a daily allowance to each cow of a small foddering of clover-hay night and morning: 1 bushel grains, mixed with cut chaff, pulped roots, and 5 lbs. Indian and rice-meal, and when full of milk, 4 lbs. or 5 lbs. cake (half decorticated cotton, and half linseed), and half a bushel of roots. Grains are high or low in price according to the abundance or scarcity of grass and roots, and the time of year—with a scarcity of roots and dear fodder they may be 6*d.* or more at Burton; in summer they are often 2*d.* or 3*d.* per bushel, malt measure. At this latter price, Mr. Hellaby generally buys his supply. He has another cistern in the stackyard which gets filled, trodden down, and covered with soil. Most of the stock seem to get grains and do well on them. Calves, sheep, dairy cows, and feeding-cattle, have them and thrive. About nine cow-calves are reared yearly, the others being sold under a week old, at 40*s.* to 50*s.* each. Those reared are fed by hand, and get from 10 pints to begin with, and gradually diminished to 3 pints, of new milk a day for ten weeks; when they get strong they are turned out, but continue to have artificial food, 1 lb. linseed-cake, and 1 lb. Indian meal a day, and a few grains. These come into the dairy at 24 to 27 months old.

Feeding Cattle.—In the meadows by the Trent, in May there were 18 very good cattle—heifers, and draft cows—eating $1\frac{1}{2}$ peck grains, and 5 lbs. maize-meal apiece daily; with them, in the 25 acres, were 16 feeding sheep. All were doing very well, and by July 7th three of the heifers had gone to the butcher at about 28*l.* a head. It was thought in December that the bull was one of Mr. Hellaby's worst beasts; by the later inspections he had improved, but did not look up to the quality of the cows; his owner valued him for his milking blood, and probably he was right. The younger bull will grow into a better animal than the other.

Horses.—Five cart-horses, two milk-horses, and one nag are kept. The cart-horses are chiefly home-bred, and are a very

useful lot. In winter their food is daily 9 lbs. maize or bean-meal, a little bran mixed with cut chaff, also a few mangolds or swedes every night.

Sheep.—Here, as with several other competitors, Shropshires are the favourites. Thirty nice ewes we saw in December. In May and July, 28 of these had reared 49 lambs, and there were 63 hoggs. The hoggs were kept in the winter on seeds, and had per head daily a few roots, 1 lb. cake (half decorticated cotton and half linseed), split peas or maize, and a few grains. Average weight of fleeces is about 9 lbs. They are sold fat at 14 or 15 months, and will weigh 88 lbs. a carcass.

Pigs.—Only a few are purchased and fed for home use.

Poultry.—Eighty or 90 hens are kept, about 110 chicken are reared, and a profit of 25*l.* is realised.

Labour.—This department seems as well managed as the others. The men seemed to work with a will, so were happy in their work, for, as H.R.H. the Duke of Albany recently said at Nottingham, "The happiness of a man does not so much depend on the value of the work he does as the spirit in which he does it." We specially noticed one bright-faced intelligent-looking lad who opened the gates for us. Three hands live in the house, one has 12*l.* 10*s.* a-year, one 11*l.*, and one 20*l.*, each with board and lodging; the two labourers have 12*s.* a-week and board.

The total cost of labour at Twyford is 23*s.* 6*d.* per acre. This is exclusive of Mr. Hellaby's very efficient help. Two cottages at 5*l.* a-year each are held by Mr. Hellaby and re-let to his men at the same rent.

Four hands and the master do the milking. There is no piece-work, except hedge-cutting and ditching at 3*s.* per acre (28 yards).

Purchased Food and Manure.—These are heavy bills, especially for food, and show an expenditure of more than 3*l.* per acre on the whole farm, but it pays to spend money thus.

Improvements.—A good part of a mile of fences have been grubbed up by the present tenant, new fences planted, the landlord finding quick; land was gained, and the new fences are straighter than the old ones, and so the fields made more convenient for ploughing, &c. He has also drained some of the land 2½ feet deep, costing for labour 2*s.* 9*d.* to 3*s.* per chain.

The buildings he has erected, which we mentioned, are shedding for 20 cows, stables for 2 horses, and styes for 20 pigs, with large granary over. The landlord gave the materials. These improvements, in addition to the laying-out of the nice garden and shrubberies, indicate Mr. Hellaby's taste and enterprise.

Fences.—Well kept and well trimmed; in the cornfields the

fences occupy very little ground, the weeds and turf having been cleared quite away, and the corn in one field growing very near to the crop in the next. The sheep appear very mild or such fences would not keep them in bounds.

Accounts seem to have been always carefully kept, and the depression in agriculture has not come heavily here. Neither should it; for if competitors for Royal honours cannot show good results, ordinary farmers *are* to be pitied.

Stenson Farm.—This farm has been in the hands of Mr. Hellaby a short time only. It is now on sale in consequence of the death of the owner, Mr. Thomas Watson, so it has never been brought into course and kept as the other has been. However, there is an excellent dairy of 28 cows there, the milk of which is sent to London on the same terms as that from the home-farm, and the cows are kept in about the same manner; also one bull, 14 dry and feeding cows, 4 young calves, and 52 fat sheep. A first-rate piece of oats, by a lot of capital mangolds and swedes, we inspected, and the barley was a very heavy and full crop. The results of farming here are quite satisfactory, and if Mr. Hellaby continued to hold it and give the same attention to it as to his home-farm its appearance would soon improve.

If the object of the Royal Agricultural Society in offering prizes for well-managed farms is to encourage skill and care among farmers, the Society has attained its purpose in this case as well as in that of the first-prize farm. Mr. Hellaby's continual care and industry, his great skill and excellent judgment, have produced results of which agriculturists of any country may be proud. And it is only justice to Mr. Hellaby to state that one of us was very decidedly of opinion that he, rather than Mr. Bryer, was entitled to the First Prize.

Mr. Arthur Stretton's Farm.

Recommended for Third Prize, Class I.

This farm (Wichnor Bridges, near Lichfield) lies on each side of the main road from Lichfield to Burton-on-Trent, six miles from Lichfield and six from Burton. The road is part of the old Roman Ikenield Street, and the house was built for a posting-house, having the sign of "The Flitch of Bacon." On reference to a History and Gazetteer of Staffordshire, by William White, 1834, we find that Wm. Stretton then lived at "The Flitch of Bacon," and the following extract about Wichnor is interesting:—

"In 1338, this manor was held by Sir Philip de Somerville, under the famous John of Gaunt, Duke of Lancaster, who, during his residence at Tutbury Castle, established several curious customs, for the purpose of gaining the affections of the people, and none of them is more singular than the tenure of this manor, which requires the lord to keep a flitch of bacon hanging in his hall at Wichnor, at all times of the year, except in Lent, that it may be delivered to any man or woman who shall come and claim it, and at the same time swear that he or she has been married a year and a day without repenting; and that if they were then single, and wished to be married again, the demandant would take the same party again before any other in the world. Two neighbours were required to testify the truth of this deposition, and if the claimant was a freeman, he received, besides the bacon, half a quarter of wheat and a cheese; and if a villain, half a quarter of rye. These things, with the bacon, were carried before him, with trumpets, tabernets, minstrels, and a procession of the tenantry, through the lordship of Wichnor, and then without music, to his abode. Since this custom was established, but very few have dared to claim the prize, and three couples only have obtained it; one of which, having quarrelled about the mode of cooking the bacon, was adjudged to return it; and the other happy couple were a sea officer and his wife, who had never seen each other from the day of their marriage till they met at the hall; and a simple pair in the neighbourhood; the husband, a good-natured sensible man, and the wife luckily dumb. No claimant for the flitch having appeared during several centuries, a wooden one was long since substituted in its stead, and still hangs in the hall—a friendly monitor to the young and free, to be cautious of trusting themselves in the hymeneal noose. The hall is supposed to stand on the site of the ancient manor house, which Leland mentions as totally in ruins in his time. The then family residence being situated close to the bank of the Trent, and much liable to the overflowings of that river, which here runs in two circuitous streams, crossed by a range of noble aqueducts forming part of the canal,* and by a stone bridge of many arches and culverts on the Lichfield and Burton road, which latter is the 'Ikenield Street' of the Romans. Near the bridge is an iron forge, established about seventy years ago, and the large 'Flitch of Bacon Inn,' where the county magistrates hold petty sessions." From 'Lewis's Dictionary' it appears James I. here held a court on August 21st, 1661.

All the land is of a light and sandy character, that easily

* The Grand Trunk Canal.

burns. The river Trent normally forms the boundary on the southern and eastern sides, but sometimes it makes nearly the whole of the land on the eastern side of the road into a vast lake. This it has done fourteen times from July 1880 to May 1881.

There are 440 acres, 170 being arable, and 270 grass-land. This farm is the property of Col. Levett, M.P., of Wichnor Park; and considering the very speculative character of the holding, he is to be much congratulated on having so industrious and enterprising a tenant willing to pay so high a rent as 1045*l.* 12*s.* The present occupier became tenant in 1876 on his mother's retirement from business, but the farm has been held by several successive generations of Strettons. Five cottages are included in the rent.

Cropping.—The course of cropping usually followed is—

1, roots.
2, wheat or barley.
3, seeds, mown or grazed.
4, " "
5, " "
6, barley, wheat, or oats.

Thus $\frac{1}{6}$th is yearly in roots, $\frac{2}{6}$ths in corn, and $\frac{3}{6}$ths in seeds. The roots grown in 1880 were of good quality, the land quite clean, and crop abundant. There were three acres of very good *Drumhead cabbages* that were being given in December to the cattle in a liberal manner. Some of Webb's early Drumhead had been drilled and cultivated as turnips are, but they were ready for use before they were wanted.

The *roots* growing in 1881 were very nicely put in on quite straight ridges, the land perfectly clean, and well manured from the fold-yards. This manure had been spread between the ridges, and they were then split back and drilled. The varieties grown were from Carter's and Webb's stocks. The mangolds had been seriously injured by the mangold fly (*Anthomyia betæ*), but at our last inspection the plants had evidently proved victorious, and promised to be a very good crop indeed.

All the mangold ground had been heavily manured on the top in winter, and then again in the ridges; then, before the seed each acre had 5 cwt. of Webb's special mangold manure, 1 ton barm (yeast), 4 cwt. to 6 cwt. salt, and some kiln-dust sown on it. After the plants were up, soot was applied to "shift" the fly.

Mr. Stretton reports to-day (July 29th) that after "thunder-rain" and great heat "the mangolds are nearly mad, and growing till one can hardly get among them."

Barley.—Large crops of barley of an excellent quality can be grown, and the 54 acres of this cereal growing in July 1881 had a full, strong, wealthy appearance, pleasant for any farmer to look at, and especially pleasant to the owner. With good weather this barley will find a ready sale in the adjoining town of Burton.

Barley is taken after two or three years' seeds on the back of one furrow, and also after roots; and Mr. Stretton is always anxious to get it in early, so that it may cover and shade the land before the hot weather comes. The early sown barley has this year come into ear kinder, and will finish better, than the later sown.

Wheat.—This crop is grown chiefly for its straw, which is used for thatching. There are 18 acres, and it is all spring wheat, the floods having lain so long on some of the land that it could not be sown in winter, except from a boat. There were also 4½ acres of excellent *oats* (Black Tartars), and 4 acres of very good spring *beans.*

Eighty acres of grass and 13 of clover would be mown for hay. It had all been spring grazed, and would not therefore cut an average crop, though the growth had been unexpectedly rapid between the May and July inspections.

Seeds are an important crop on this holding. They are sown on the barley or wheat after roots, the quantities being 12 lbs. of small seeds, consisting of red clover, white clover, alsyke, cowgrass, ribgrass, and trefoil, and 2 pecks of imported Italian ryegrass per acre. These are kept down two or three years, either for mowing or for grazing, with the cattle or sheep, a considerable number of each being kept.

Clovers are not generally mown, but when a field is without water, as several now are, the landlord not having replaced the floodgates where the old forge has been taken down, it may be best to mow it. All seeds are manured once or twice whilst they are down; cake and corn are also consumed on them, otherwise the fertility of this hungry land could not be kept up.

Cattle.—The numbers of cattle were as follow:—

December.	*May.*	*July.*
2 Bulls.	2 Bulls.	2 Bulls.
51 Cows in milk.	63 Cows in milk.	64 Cows in milk.
10 Feeders.	14 Feeders.	7 Feeders.
14 In-calf heifers.	18 Stirks.	4 Dry cows.
26 Yearling "	10 Yearlings.	10 Yearlings.
26 Calves.	41 Rearing calves.	16 Three-year-old heifers.
	4 Dry cows.	40 Rearing calves.
		4 Fat calves.
129	152	147

The milk is sold to a London Dairy Company, of which Mr. Stretton is one of the two chief proprietors. Thus he gets the large profit of the London retailer as well as that of the producer, and he is to be congratulated on the successful working out of the theory that the producer should sell to the consumer.

The price obtained from the Company is 1*s.* 10*d.* per barn gallon (17 pints) from October to April, and 1*s.* 7*d.* from April to October, the sender paying 2*d.* per "barn" carriage. The milk is cooled in Lawrence's refrigerator, and sent morning and evening from Barton and Walton station by the Midland Railway Company.

When milk is abundant in May and June some cheese and butter are made. The average amount received per annum for cheese in the last three years was 220*l.*, and for butter 128*l.* For milk it is much larger, being an average of 1218*l.* In the past year 28 cows cast their calves, this was of course a serious loss. In looking for the probable cause some ergot was found in the pastures, and might be responsible for some of the mischief, but it must be injurious to in-calf cows to have to labour through the wet heavy yards as they have to do all winter to get from the inconvenient cow-sheds to the poor drinking accommodation outside. Improvement here is greatly needed. There were 51 cows in milk in December in the wretched wet yards and miserable cowsheds which are to be found on this holding; no competitor, and we hope no farmer on this side the Irish Channel, is so badly off for farm buildings as Mr. Stretton; it is impossible to make the best of fodder, cattle, or manure with such primitive appliances as are here provided by the landowner for his excellent tenant.

At the subsequent inspections a larger number of cows were in milk, and their condition was greatly improved; Mr. Stretton explained that in the autumn they looked worse than usual, because their food had been destroyed. A large breadth (88 acres) of most excellent aftermath was turned into, and within three days the swollen Trent rolled over the whole, and in December we saw it lying prone and useless in the meadows. There were in December but 4 waggon-loads of *good* hay, all the other had been sanded and spoiled by water. The labour bill and the cost of the cattle's keep must have been greatly increased by these disastrous floods.

Sheep.—There is here an excellent flock of sheep, not fancy sheep, but real rent-payers. They are of the Shropshire breed, and of excellent quality; most of them have been bred on the farm, well-bred sires having been used; the four rams we saw were from the flocks of Clare, Bradburn, Graham,

and Masfen. Some 55 sheep were lost last year from liver-rot, besides others being sold from 5*s.* to 15*s.* a-head, but all seemed in good health in 1881. At our first inspection there were of all ages 344 sheep, and at our later visits, 458. In December the ewes were on second seeds, and having cut chaff and swedes; the hoggs were on turnips; the ewe-hoggs, kept for filling up the ewe flock, were having ½ lb. per day of cotton-cake with malt dust, barley, and clover chaff. The feeding hoggs had more, in fact they had all they would eat of linseed, decorticated cotton-cake, and peas. There has been in 1881 a good crop of lambs, 169 from 119 ewes, and though they had no artificial food since the lambs were strong enough to leave the lambing folds; they were in the finest condition, some of them having been sold to the butcher in June at 46*s.* per head. With many farmers in this district Shropshire sheep are the favourites, and from what we have seen here and elsewhere we think they deserve to be.

Horses.—There were 7 cart horses, besides 3 young ones, which were put to work when the mares had foals, and during turnip sowing; they were afterwards turned out until harvest.

There were also 3 foals, 1 nag, and a milk pony. During the winter their weekly allowance of corn is 6 bushels of kibbled old barley, or other corn, for 7 horses, a few grains, 2 swedes a-day a-piece, and clover-hay *ad lib.* Some good foals are bred, and sold at Burton winter fair (29 Oct.) for good prices. Three were out in a grass field with one mare, the other two mothers being at work.

Pigs.—Eight pigs of the Stockley Park breed and 4 half-bred Tamworths were the well-kept occupiers of the pigstyes.

Labour.—The average annual cost of labour for the past three years has been about 28*s.* 6*d.* per acre. Seven or eight labourers are employed at wages from 17*s.* 6*d.* a-week for the waggoner, with a house, to 19*s.* without a house, for the shepherd. Three boys at 8*l.* 10*s.*, 6*l.* 10*s.*, and 3*l.* a-year, board and lodge in the house; in the spring, women are employed at 1*s.* per day at weeding, &c. Seven or eight hands and the master do the milking.

The board and lodging of the boys is reckoned at 7*s.* per head per week. It had been the practice to give food and beer to the men during harvest, but Mr. Stretton has not done so for the last three years; this year he has agreed to give 3*l.* 10*s.* per head for harvest wages, and no food or drink. There is also a dairy girl, who receives 14*l.* a-year, and lives in the house, but the dairy is under the efficient management of Mrs. Stretton.

Purchased Food and Manure.—A large quantity of home-grown corn has been consumed on the farm, still the figures

given for artificial manures and bought food are considerable, and stand thus:—

Years.	Corn, Hay, Malt-culms, Grains, and Cakes.			Manures.			Total.		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
1878	326	1	3	86	10	9	412	12	0
1879	564	15	5	107	8	8	672	4	1
1880	389	11	11	102	5	3	491	17	2

This is equal to about 32*s.* 10*d.* per acre per annum on the average of three years.

Where milk is produced all the year round many grains are used, and judicious managers buy them, as Mr. Stretton does, in the summer at about 2½*d.* per bushel, and store them in air-tight cisterns.

Improvements.—Draining has been done with very good effect in the meadows, though the very level lie of the land makes it difficult to get a good fall. Some draining was being finished in May, the landlord finding pipes and the tenant labour. Twelve hundred yards of old fences have been grubbed, and 300 yards of new have been planted.

Implements.—There is a good assortment of implements suitable to the holding, and we found all that were not in use cleaned, repaired, and properly put away under cover.

Accounts.—The accounts appear to have been kept with great accuracy, but through foreign competition and losses by floods and sheep, Mr. Stretton is not able to show a result as good as he deserves, when we consider the very large quantity of stock kept, the considerable capital invested, and the untiring industry of Mr. Stretton and his worthy helpmeet. Through the floods, the fences had required and received very great attention. In many places the roads and gateways had been washed away, and had been carted back again; the banks and hedges had been carried away bodily, and were brought back and replaced, and the exposed roots of fences carefully covered up; the gates had been prevented following the fences by being fastened to the posts by chains and staples. Miles of fences had been freed from drift and weeds before they could start to grow properly. Under such circumstances too much praise can scarcely be given to the tireless energy of Mr. Stretton, and the Judges had great pleasure in recommending that a third prize be awarded to him.

The Croxden Abbey Farms.

It was early on a bright December morning that we met the late Mr. Carrington at Rowcester station. He had just delivered there a magnificent fat Shorthorn bull on its way to the shambles. It was a truly grand animal, long, deep and level, full of flesh everywhere, without being excessively fat, with a mellow touch and a good bull's hide, covered with a silky rich roan coat. A weighing-machine being at hand, we requested to know his live-weight. At 22 cwts. the beam was raised. Being so thoroughly well made up, we estimated the dead-weight at $\frac{2}{3}$rds of the living carcass. The calculation proved extremely accurate, as the 4 quarters (the hind being as heavy as the fore), weighed 1646 lbs., which, at 7*d.* per lb., the price made, was some substantial compensation for the loss of such a noble sire from the farm. We first drove to Nothill, an out-of-the-way cold clay farm, which is now almost all pasture, with no redeeming feature upon it save a tract of useful water-meadow, which was then being irrigated. This farm being devoted to cheese-making, had a herd of splendid cows, then very low in milk. Their produce in the winter was converted into butter. The buildings were quite inadequate to properly house such excellent stock, and a few well-bred heifers were in a grass field, there being no yard or any kind of shelter for them. A splendid young bull, the "Prince of the Pinks 2nd," was kept here, taking the place of the grand old animal we had seen at the station. After inspecting a small farm at Hollington, which belongs to the Carrington family, upon which were some capital dairy cattle (their milk being mostly sold in the village), we came to Croxden, with the extensive and beautiful ruins of its glorious old Abbey. This Abbey was founded in 1176, by Bertram de Verdon, for monks of the Cistercian order, and it is said the heart of King John was interred here, while his body was buried at Worcester. It has been suggested "that perhaps the most precious portion of this monarch's remains would be the hand that signed Magna Charta, and Croxden may be welcome to the heart which reluctantly consented to the glorious deed." These ruins must be intensely interesting to the antiquarian, the historian, and the artist; but we must leave them for the fertile farm which Mr. Carrington did so much to make celebrated and improve. It had none of that prim smart appearance, which is a usual feature in competing farms; the fences are mostly high for the protection of the cattle, and are purposely left rough to shelter them from rain and sun. The farm lies on either side of a pretty little valley, watered by the Peak rivulet, which is

utilised for irrigation, and also for driving a small mill at the homestead and some fixed machinery. The cows here had a more thoroughbred look than those at the other farms, but we did not think their milking properties were increased by the purity of their blood, notwithstanding all the care taken to select animals from herds celebrated as milking Shorthorns. A grander dairy of cows, and a more perfect collection of well-grown, healthy young stock, it has never been our pleasure to inspect, and the prices they realised at the recent sale will testify how the public appreciated their excellence.*

At the time of our December visit, each cow in milk was having long hay *ad lib.;* 4 lbs. of decorticated cotton-cake, 2 lbs. of mixed meal, and 1 lb. of malt culms (soaked); and ½ ton of pulped roots were daily given to 60 cows, a trifle under 20 lbs. a-day each. Besides these pulped roots, each cow was allowed two or three whole swedes or cabbages. In the winter all the milk produced at Croxden Abbey was sent to London; but in July we found that in consequence of the failure of the buyer to fulfil his contract, all the milk was being made into cheese. Instead of attempting a further description of the manner in which the late Mr. Carrington managed his stock and cultivated his land, we are sure the readers of the 'Journal' will be much better pleased and instructed by perusing the following account written by that distinguished dairy-farmer. And it will increase its interest when it is known that these details of the agriculture he practised so successfully were almost the last production of his powerful and ever-ready pen.

* At the Croxden Abbey Sale, when Messrs. Lythall and Mansell sold the large Shorthorn herd of the late Mr. W. T. Carrington, the prices were altogether highly satisfactory. One hundred and thirty cows in-milk or in-calf, including thirty-four calves, realised 4332*l.* 6*s.*, or an average of 31*l.* 8*s.*; twenty yearling heifers were sold for 451*l.*, an average of 22*l.* 11*s.*; and four bulls (one only seven months old) realised 188*l.*, an average of 47*l.* each. Turning to particulars, "Neatness," a fourteen-year-old cow, a winner of a first prize at Wolverhampton, and dam of "Sir Sidney Newport," a Birmingham 50*l.* champion-cup bull, was secured by Lord Middleton for 39 guineas; "Dainty," calved in 1875, was bought by Mr. Thornton for 41 guineas; "Young Dairymaid," of the same age, and winner of several prizes, went for 42 guineas to Capt. Duncombe, who secured also "Dairymaid," her twin sister, and also a prize winner, for 55 guineas. "Spangle," calved in 1878, was bought by Mr. Ashton for 48 guineas; "Lady Emily," the same age, fell to Lord Middleton for 46 guineas; "Rose," calved in 1875, was bought by Mr. Oates for 40 guineas, and at the same figure, "Ringlet," of a similar age, fell to Mr. Thornton; "Pattie," calved in 1874, was bought by Mr. Hancock for 41 guineas; "Claire," calved in 1872, went to Mr. F. T. Wright for 40 guineas. For "Broadmoor Prince," a roan yearling bull by Sir Robert Frogmore (40,719), and out of "Neatness," the old cow alluded to above, 32 guineas was realised. There was considerable competition for "Prince Charmer," another yearling, which went to Mr. Cummings for 60 guineas, and "Prince of the Pinks 2nd," by "Grand Duke of Geneva 2nd," which has been in service, realised 82 guineas. These were the leading prices; but as will be understood by the averages given above, very few animals, except calves, went for absolutely low rates.

W. T. Carrington owned six cottages, and rented two with the Hollington Farm. These are, with one exception, occupied by labourers, most of whom work on the Abbey Farm.

One cottage has 3 acres of grass land attached, and the labourer keeps a cow which yields him a profitable return. Two other labourers occupy small holdings, and each keeps two cows.

The total acreage mown for hay every year is as follows:—

Abbey Farm	63 acres.
Nothill Farm	22 „
Springfields	11½ „
Hollington	15 „
Total	111½ „

When grass is abundant at the mowing season an extra field is sometimes shut up for a short time and mown for hay, or portions of fields where the grass is strong are sometimes mown. In addition, 8 acres of clover were mown in 1880, but this was exceptional.

The Nothill Farm is almost wholly devoted to cheese-making, from 10 to 14 heifer calves being reared on the skim-milk or whey porridge, and kept until 12 months old on that farm, when they are grazed on other portions of the occupation until brought into the dairy. On the Abbey Farm the pastures are chiefly grazed by dairy cows, the milk from which is sent to London twice daily, except in the winter months, when it is sent once only.

About 10 or 12 heifer calves and a few bull calves are reared annually, and some cows in milk are bought to keep up the supply, also some barren cows or young cattle for summer grazing. A flock of 80 Shropshire ewes has been kept until the autumn of 1879, their lambs being (except about 30 ewe lambs retained to keep up the flock) fattened at from 1 year 2 months old to 1 year 6 months, and some young sheep being also bought for fattening. The ewes becoming tainted with fluke in 1879, like nearly all the sheep in this district, were sold chiefly at moderate prices to the butcher, and their lambs have all been fattened out, proving, though fat, unsound in their livers.

It is not intended to keep a breeding flock again, at least for the present, as nearly all the land is unsuitable and risky in wet seasons for sheep, and they are also always troubled with foot-rot when grazing on these pastures. The only sheep now on the farm are 50 wethers, bought for feeding, and sold by weight at 10*d.* per lb. On the Hollington Farm from 12 to

DETAILS of the FARMS in the OCCUPATION of the late Mr. W. T. CARRINGTON.

	Acres.	Rents.	Land Tax.	Tithe.	Rates.	Owners.
		£	£ s.	£ s.		
Abbey Farm, with small mill assessed at 20*l.*	316	566	8 10	0 12	1*s.* 8*d.* in pound, or say 3*s.* per acre	The Earl of Macclesfield.
Nothill Farm	180	220	4 0	Nil.	1*s.* 8*d.* or 2*s.* per acre	The Earl of Macclesfield.
Springfields land	57	160	2 0	8 10	1*s.* 6*d.* or 4*s.* per acre	H. Dalton, Esq.
Hollington Farm and two cottages	60	120	4 0	8 0	1*s.* 6*d.* or 3*s.* per acre	Trustees of late J. Carrington.
Heathland	24	Estimated Value 50	..	..	..	W. T. Carrington.
Longclose Meadow	$3\frac{1}{2}$	Rent 9	..	..	..	Rev. E. Philips.

20 cows in milk are kept throughout the year, milk being sold daily for the use of the village, and the rest of the milk is made into butter or given to calves for rearing or fattening. The draft barren cows from the other farms are fattened on one portion of the grass land with cake. The number of cows in the shed at the Nothill Farm at the date of the first visit was 31, all of which were in milk, though nearly all had calved in the previous spring, and were giving but little. On the Abbey Farm, at the same date, 67 were tied up. Of these 8 were fatting, 10 were dry, being heavy in calf, 10 more had calved within the last 3 months, and the remainder were in milk, but many of them were being gradually dried.

At Hollington Farm 25 were tied up, 3 being fattened, 6 having recently calved, and 10 more giving some milk.

The total number of cattle of all ages was 200 head.

Fifty-two sheep, being wethers 18 months old, were then the only sheep on the farm, purchased October 22nd at 44*s.* each, they are now sold to go off in January and February at 10*d.* per lb.

Six good working horses are generally kept, besides one or two breeding mares, which are worked except for some time after foaling. Most of the horses are 2, 3, or 4 years old, being reared, broken in at 2 years old, worked and sold out for town work at 4 or 5 when at their best. Two were thus sold last year at 66*l.* and 70*l.*, and when horses were dearer much higher prices were realised.

About 100 pigs have been purchased during the year 1880, costing about 55*s.* each, and realising about 5*l.* 6*s.* each, after being kept an average of 12 weeks, with an average increase of value at 4*s.* 3*d.* per head per week. Most of the pigs have been fattened on the whey at the Nothill Farm with an allowance of maize and rice-meal or sharps, costing 2*s.* to 2*s.* 3*d.* per head per week for corn. The remainder have been fed on the skim-milk, waste potatoes, &c., with meal, at the other farms. Not one pig has been lost in the past year.

The feeding of the dairy cows may be described as follows: On the Nothill Farm, where the milk is used almost entirely for cheese-making, the cows nearly all calve from the middle of January to the middle of May, and most of them in March and April. They are generally let dry about two months before calving, their food in the winter being straw or coarse hay, whole swedes being also given, and 2 to 4 lbs. decorticated cotton-cake, if young growing beasts or giving much milk. After calving good hay is given, a few turnips, 3 lbs. of cotton-cake and 3 lbs. rice-meal daily. When the cows go out to

grass the allowance of cake is generally continued, the herbage being naturally somewhat rough and coarse.

Last year 2 lbs. of decorticated cotton-cake and 2 lbs. of rice-meal were given (the herbage being worse than usual in consequence of excessive wet) with good result as far as regards the yield of cheese, but the use of meal appeared to have the effect of causing more of the cows than usual to prove barren in the autumn.

At the Abbey Farm the milk is nearly all sent to London, and a supply is required in the winter months, though twice as much is sent off daily in summer as in winter.

Cows calve in every month of the year, though more calve in the spring months than at other times. By means of water-power, barley and oat straw are cut into chaff, and roots are pulped from the middle of October to the middle or end of April. The chopping is done about three times per week. Two cwts. of malt-dust is soaked and mixed with each chopping, which flavours and renders it palatable.

All the beasts housed at the Abbey Farm have chop (chaff). Those which have recently calved and are giving plenty of milk, and those fattening for beef, have 2 or 3 lbs. each daily of rice-meal mixed with the chop, and 3 lbs. decorticated cotton-cake, with a few additional whole mangolds or swedes, the former being reserved for the milch cows. All the cows have a little long hay, the best being reserved for the new milch cows and for eating late in the spring. The barren cows from the Nothill Farm are kept through the winter and milked at the Abbey Farm. Linseed-cake is, as a rule, only given to cows which are delicate, to calves, and to bulls,—decorticated cotton-cake being found more economical and perfectly safe when given in moderation to healthy cattle. In fact, after a large use of it for many years, I can state that I have never traced any injurious effects to its use.

From 20 to 30 heifer calves are usually reared annually, and a few bull calves for use, or for sale for stock purposes.

The rest are sold at about a week old. Those by a pedigree bull from my own cows at 3*l.* each, and a few selected ones at much higher figures. The calves from bought cows of no special breeding are sold at what they will fetch, from 20*s.* to 30*s.* each.

The total amount received for milk sent to London from the Abbey Farm was—

	£	*s.*
In 1880	1000	15
In 1879	1024	1

From this, however, must be deducted the carriage, $1\frac{1}{4}d.$ per imp. gal., being from one-sixth to one-eighth of the above sums.

The price of milk has been 1*s.* 5½*d.* per barn gallon (of 17 pints) from April 1st to October 1st, delivered in London; 1*s.* 10*d.* for October, November, February; 1*s.* 11*d.* December and January, and 1*s.* 7*d.* in March. The net price being a fraction over 7*d.* clear per imp. gal. in summer, and 9*d.* and a fraction in winter.

The arable land was cropped in 1880 as follows:—

	Acres.		
Wheat	28		
Oats	22		
Barley	7½		
Roots	25	Swedes	11
		White Turnips	4
		Mangolds	6
		Cabbages	2
		Potatoes	2
Seeds, besides 5 acres of permanent seeds	4		
Total	86½		

Six or eight acres of cabbages are usually grown, but last winter destroyed many plants, and swedes were substituted. 34 acres of wheat are now sown, 18 acres being after roots.

The amount of purchased feeding stuffs has been large. The home-grown corn has been sold. Some black oats and all inferior or light corn have been crushed and used.

1880. Cash. £	s.	d.		1879. £	s.	d.
640	0	0	Decorticated cotton-cake	610	0	0
170	0	0	Linseed-cake	275	0	0
35	10	0	Palm-nut meal	40	7	6
232	0	0	Maize and rice-meal for cows, pigs and horses	335	0	0
50	0	0	Malt-dust	40	0	0
1127	10	0		1300	7	6
115	10	0	Purchased manures, chiefly fish-guano, mineral superphosphate, nitrate of soda, and bone-meal	164	11	0

The quantity of cheese made at the Nothill Farm in 1880 exceeded 8 tons 10 cwts. of 120 lbs. to the cwt. (the weight being taken at the time of sale). About 3 tons is as yet on hand, but there is every probability of an average price of 80*s.* per 120 lbs. being realised on the whole year's make.

Samples of this cheese were exhibited at the Staffordshire, Derby, and Manchester and Liverpool Shows, winning 1st, 2nd, and 3rd prizes, 17*l.* 10*s.* in value.

In 1879, two Royal Agricultural Society's 1st prizes were won, and 33*l.* in all. Butter, chiefly whey, except for a short time in winter, made at the Nothill Farm in 1880, sold for 85*l.*, being

at an average price of rather more than 1*s.* 4*d.* per lb. At the Abbey Farm, about 10 cwts. of cheese, worth 40*l.*, and butter sold for 12*l.* 16*s.* 8*d.*, were made in 1880. At Hollington the sale of milk and cream has averaged in the last three years 3*l.* per week, and butter has been sold to the value of 80*l.* per year.

1880.

	£	s.
Eggs have been sold from Abbey Farm to the value of ..	30	0
Hollington	10	8
Nothill	8	10
Geese have been sold to the value of	10	0
Other poultry, about	5	0

Ten labourers are regularly employed, four of whom have their board.

Besides these there is a foreman at the Nothill Farm, whose wife makes the cheese, assisted by a strong girl. This foreman also does most of the carpenter's work at that farm, and there are two young Irishmen who lodge at the farmstead.

Two boys are also boarded and lodged at the Abbey Farm.

One dairywoman is employed at the Abbey Farm to attend to the milk and assist in housework.

The cost in labour in 1880 was—

	£
In cash	710
Estimated cost of board and other extras ..	250
	960

No beer has been given for the last two years.

With regard to improvements on the Nothill Farm during the twenty-five years with which I have been connected with the management, about 80 acres have been drained 4 feet deep, and about 10 yards apart, at the cost of about 5*l.* per acre, the whole of which was borne by myself. Most of this work was done from twelve to twenty years ago.

Fifteen acres were seeded permanently seven years ago, and have been repeatedly top-dressed. Thirty acres were seeded shortly before it came into my hands. One field was laid down last year. A large number of useless hedges, which on this wet soil caused much treading of stock, have been cleared away. The farm was entirely without roads, and in a wet time was very much trodden up about the house; 400 or 500 tons of road material have been carted on to the farm in the last three years, the landlord paying cost of material at the wharf.

By continuous liberal feeding to cattle and pigs, and especially by a free use of decorticated cotton-cake to dairy cows in the summer, the productiveness of the pastures on this farm, which were previously very poor, has been much increased.

On the Abbey Farm, during the seven years it has been in my occupation, since my late father's decease, from 25 to 30 acres have been regularly drained 4 feet deep at my sole cost, and one field 6 acres permanently seeded.

On one side of the farm, where some exchange of land was made, about a mile of useless hedges was taken out at my cost. Nearly 40 acres of young turf have been specially treated with repeated top-dressings, or large consumption of such feeding-stuffs as decorticated cotton-cake and malt-dust on the land, with a thoroughly successful result in the improvement of the turf.

I have been connected with the management of the Abbey Farm from a boy, and I took an active part of it in the later years of my father's lifetime. On the Hollington Farm, I claim to have brought the land from very moderate turf, into most productive feeding-land, chiefly by the aid of cake-feeding and small dressings of mineral superphosphate and nitrate of soda. This land has been actually in my occupation for 19 years.

Description of Root Culture.—The land intended for roots is ploughed 7 inches deep as early in the autumn as it can be done, care being taken not to plough strong land when wet.

Where any couch or weeds exist on the corn-stubbles, they are scarified and cleaned as soon as cleared after harvest, but in a late harvest or a wet autumn this cannot be thoroughly done. Where land is, as I generally have it, clean and free from annuals, I do not consider autumn cultivation necessary.

Dung is never applied for roots in the autumn, as it has been found that it makes strong soil too retentive of moisture, and prevents the land from working freely in the spring.

In frosty weather fresh dung is carted to large heaps against the land where it is required.

In March this is carted on the land intended for cabbages, 20 tons per acre, spread and ploughed in during dry weather. The land is then left untouched until the middle or latter end of April, when the surface is thoroughly stirred with a cultivator or iron harrows, and 4 cwts. mineral superphosphate (26 per cent. sol.), and 3 cwts. of fish-guano, are sown broadcast or with a manure drill, and worked in on the surface made fine and level. It is then marked out both ways with the tines of a drill, and set the desired distance (about 30 inches). Wherever the marks intersect each other, a plant is set; all measuring is thus avoided, and the crop can be horse-hoed both ways.

The cabbage-plants (Drumhead) are grown in a large garden from seed sown in August.

In June, 2 cwts. per acre of nitrate of soda, when not too dear, are sown on the plants before they get large; this additional dressing largely increases the weight in a good season.

The crop is consumed from September to Christmas.

Mangolds are all sown on ridges 27 inches apart.

The land ploughed in autumn and pulverised by frost is worked and ridged in March or early in April; 15 loads of dung per acre are put in ridges, and the same dressing of artificials is given as for cabbages, with the addition of 3 cwts. per acre of salt. I like to sow them early in April, if the spring be favourable. Unless sown early in this county, they rarely make a full crop, and the hotter the season the better they thrive. After the mangolds are sown, the swede-land is prepared in the same way, 8 to 10 loads of dung, and the same superphosphate and guano being added, but no salt or nitrate of soda. I like to sow swedes early in May, as they do not often mildew. I often grow swedes without farm dung, but with a larger dressing of artificials, and they succeed well. Great care is used to get a good tilth and not to go on in wet weather. White turnip sowing succeeds that of swedes. The whole of the roots are carted off the land.

I have every year succeeded in winning prizes for roots, generally both for growing crops and pulled roots, at the County and District Society's competitions. Last year I won 1st for each sort of mangolds, and 2nd for a collection at the Staffordshire Show; and 1st swedes, 1st cabbages, and 2nd mangolds for the best crops in the Uttoxeter district, about 10 miles (each way).

The artificial dressing for roots costs as follows:—

		Per Acre. £	s.	d.
4 cwts. mineral superphosphates, at 3*s.* 6*d.*	=	0	14	0
3 cwts. fish-guano, at 8*s.* 6*d.*	=	1	5	6
		1	19	6

Roots are repeated more frequently on those fields where the soil is most suited for root-growing and which are nearest the homestead, and thus most convenient for carting roots off and dung on.

With my limited quantity of arable land, I find any strict adherence to rotation of cropping unnecessary and undesirable.

Most of the dung made in the winter is applied for roots. Any remaining over is applied to mowing land after it is cleared in July, or after the first-grown aftermath is eaten off. It always answers well applied at such times, which are preferred to the winter.

Some dung is also occasionally spared for top-dressing young turf.

Mr. Richard Finney's Farm.

Highly Commended—Class I.

Hemington is a pretty village lying sheltered in a little valley between Kegworth and Castle Donington. At the latter place, and at Melbourne, near to it, many hands are engaged in market-gardening; among other crops acres of quick (white-thorn) and cabbage-plants, chiefly Drumhead, are yearly raised. The populous villages of Sawley and Long Eaton are also within a few miles. The women of these villages rarely work on the farms, as they can earn more at home; and we saw them gathered about the doors, "seaming" hose, "clipping" or "mending" lace,—work that they get from neighbouring factories. Children are also employed "beading" and "seaming" at home, and many go daily to the factories. A small stream, which is not polluted with sewage, runs by the side of the road through the village, and adds to the pleasantness of the place. On a rising ground is an old ruined church, which looks as if it had never been completed, and in the village are well-built modern public schools. Castle Donington station is only about half a mile away, but it cannot be reached by road under 2 miles' drive. This is so great an inconvenience, especially for those who twice daily send milk to the station, that a public road is about to be made across a field in the occupation of Mr. Finney, which will give the needed accommodation.

Mr. Finney's house is 9 miles from Derby, but some of his farm may be much nearer, as it is quite 4 miles from end to end, reaching from the Trent, by Sawley Bridge, in Derbyshire, to the hills east of Castle Donington, in Leicestershire. The farm is in several detached lots, which increases the difficulty of personal superintendence. There are 180 acres of arable land and 240 acres of grass; moderately light to heavy, lying mostly on a gravel or clay subsoil. Part of it is owned by Sir J. H. Crewe, of Calke Abbey, on which Mr. Finney entered in 1866; and part belongs to N. C. Curzon, Esq., Lockington Hall, Derby. Of this Mr. Finney became tenant in 1877. The land nearest to the Trent, both arable and pasture, was repeatedly flooded during last winter. Some damage was done to the wheat, and much to the grass-land; for on this farm, as on all we inspected, grass-land had greatly deteriorated within the last three or four years. Nearly all the finer grasses are gone, and until they are again present the land will not, unassisted, keep so much stock, neither will it make so much milk or meat as it did before the wet seasons.

By judicious and generous management improvement may be facilitated, but the quality of the pastures cannot be fully restored without a repetition of dryer seasons and more sunshine than we have had for some years before this one. Mr. Curzon's land is occupied under the Agricultural Holdings Act, and Sir J. H. Crewe's under a yearly agreement, by which the tenant would on leaving be allowed compensation for unexhausted improvements, on the same scale as would the winner of the second prize, who farms under the same landlord.

There is a very good modern farmhouse, with convenient buildings and yards, though, with all Mr. Finney's cattle, he could well do with more accommodation in the winter. The kitchen, dairy, and milk-house, with all the fittings, are kept in a manner that reflects the highest credit on the management; indeed, it would be difficult to speak too highly in praise of any department that is under the personal care of Mrs. Finney. There is a second homestead, with a good though smaller house. The house is sublet, and the very old buildings were in July being taken down, and good new stables, &c., were being built; if more attention is given to ventilation than has been in the cowsheds in use it will be an advantage. This will add much to the convenience of the holding. There are two cottages let with the farm, and included in the rent. One of them is let to the stock-man, and reckoned at 2*s.* per week. There is a large quantity of timber on the farm, mostly ash and wych-elm (which might with profit to the owner, and considerable advantage to the tenant, be thinned); also a good orchard, which has this year a good crop of fruit in it.

The Course of Cropping generally followed is—

Turnips or fallow.
Barley or wheat.
Seeds, lying down 1 to 4 years.
Wheat.
Barley.

Crops.—This year are—

32 acres wheat.
80 ,, barley.
16 ,, first seeds.
20 ,, second seeds.
12 ,, mangolds.
10 ,, swedes and potatoes.
17 ,, turnips.

The wheat was of a good colour, generally clean, but not very thick on the ground, the plant having been in some places destroyed by the floods that lay on it last winter.

Barley.—The large breadth of barley looked like being a generally good crop, and if sold as well as it was last year (42*s.* or 43*s.* per quarter) will make a nice sum of money. Several fields at our May inspection threatened to be full of weeds, but the hoe had changed all that before our visit in July.

Seeds.—At our July visit some clover-hay was being led in excellent order. There was a fair crop, tall, but not thick. Several other fields were being grazed with sheep, and it was proposed to break up one field that was not clean. All the young clovers seemed to be an excellent plant. Mr. Finney's usual mixture is 12 lbs. clover, red and alsyke, and 1 peck of Italian rye-grass. Seeds on this farm had been supplied by three firms, Barron, Carter, and Webb.

Mangolds.—A ten-acre piece of mangolds near the Trent looked promising, though the mangold-fly had made great havoc in them between the May and July inspections. The land for mangolds was steam-ploughed in the autumn about 7 inches deep. Twenty tons of night-soil that had been brought up the Trent from Nottingham, and delivered near the field at 2*s.* 9*d.* per ton, were put on each acre with half a ton of soot early in April. The land was then well harrowed, and on April 18th drilled on the flat, 21 inches from row to row, and plants were set out at 9 inches apart.

Some swedes were an excellent plant, drilled on the flat, horse-hoed, and struck out by July 11th. They looked very clean and promising. We saw two single horse-hoes at work, one boy walking between and leading both horses.

The following was a preparation for another lot of swedes. The ground was ploughed in the winter, well worked, and re-ploughed in spring; 10 cart-loads of rotten dung were spread in ridges, and 4 cwts. per acre of dissolved bones added; and, as the weather was then dry, care was taken to cover in the dung and drill up to the plough each evening.

Cattle.—One feature of this farm is the excellence of the cattle; and the way in which this quality was obtained is worthy of notice. For many years past well-bred Shorthorn sires have been kept, and their impression on the stock is very well marked. There seems to have been a steady and continual improvement in quality. Among the dairy cattle were excellent animals, which will make fine pieces of beef when it seems best to draft them out. Indeed their frames were so good, and their feeding properties so evident, that it seemed an open question whether beef had not developed faster than milk. The numbers of cattle in December and May are given below, July being the same as May:—

December.	*May.*
25 Cows in milk.	27 Cows in milk.
8 „ dry.	9 In-calf heifers.
10 „ feeding.	10 Heifers under 2 years.
11 Steers, 2 years old.	10 Feeding steers, 2 years old.
10 Heifers „	10 Bullocks under 2 „
20 Yearlings.	10 Cows in calf.
11 Calves.	24 Calves.
1 Bull.	2 Bulls.
96	102

An excellent well-bred bull is now used, and Mr. Finney purchased at Pendeford sale, to follow him, "Dizzy," the nicest calf off the best milker when the late Mr. Masfen's herd was distributed. All the calves are reared, the heifers come into the dairy, and the steers make a good sum when fat, at 3 years old.

Mr. Finney has been sending his milk to London seven or eight years. The price obtained is—

From April 1 to Oct. 1, 1*s.* 5*d.* per barn gallon (17 pints).
„ Oct. 1 „ Jan. 1, 1*s.* 9*d.* „ „ „
„ Jan. 1 „ April 1, 1*s.* 10*d.* „ „ „

A little more is supplied in summer than in winter. The sender delivers twice daily at Castle Donington station, and pays 2*d.* per "barn" for carriage. In winter the dairy-cows were fed on long hay and barley-straw-chaff, and each cow daily received half a bushel of grains, half a bushel roots, and 3 lbs. rice meal.

Sheep.—There were 256 sheep on the farm in December. The 116 hoggs were within hurdles on the turnip-ground, and were having as many cut swedes as they could eat, with hay, straw-chaff, and half a pound per head per day of linseed-cake and maize-meal. Half this crop of swedes had been removed for the cattle; the sheep were eating the remaining half, which had been well pitted. The nice flock of 137 Improved Leicester ewes were running on grass-land. A good crop of strong lambs were with these, on seeds, in July, and part of the hoggs were sold. Those left were very good meat. In July the numbers were: 120 ewes, 86 fat wethers, 10 fat sheep, 30 theaves, 160 lambs, and 3 rams.

Pigs.—Here, as on most farms where milk is sold, pigs are not numerous. In December there was 1 good white sow, with 8 little ones, which were sold for stores at 8 weeks old. In May she had 8 other little ones, 10 of the same litter having died!

Horses.—Eight working horses and two brood mares are kept; all are of a very useful type. Two foals are generally reared,

and two were here now. Their food consists in winter of 10 lbs. daily of old beans and maize for each, 1 cwt. per week of bran among them, and a few swedes; clover-hay, and cut chaff *ad lib.*

Labour.—As Mr. Finney lives in a village and has plenty of cottages near him he departs from the ordinary practice of this district, and all his hands board and lodge out of the house. Two labourers (stock-men) have 18*s.* a week each; two, 16*s.* each; one, 17*s.*; waggoner, 19*s.*; and one stock-man 18*s.* and his cottage; one boy at 8*s.*, and two at 5*s.* each, the total cost of labour being about 23*s.* per acre;* thatching at 6*s.* per day.

Purchased Food and Manure.—For last year these bills amounted to 388*l.*, or about 18*s.* 4*d.* per acre.

The *Accounts* were well kept, on Webb's system, which in Mr. Finney's hands supplied ready answers to all questions on this crucial and important point. Chaff-cutting is done here and in this neighbourhood by Maynard's chaff-cutters, which travel with steam threshing-machines. The charge for the chaff-cutter is 20*s.* per day, and two extra men will feed it with all the straw threshed in a day. This can be stored in far less compass than the straw can be, and is a ready and abundant supply for horses, cattle, and sheep during the winter months.

The Judges desired to mark their appreciation of Mr. Finney's successful cultivation of his disjointed and inconvenient holding by awarding him a high commendation.

Mr. Archer, Ashbourne Lodge, near Ashbourne.

Class I.

Dame Nature must have been in one of her most charming moods when she designed the country about Ashbourne, and those who chose the site of Ashbourne Lodge were good judges. Resting on a little platform, that may have been an old landslip from the older hills, sheltered by its orchard behind, which, in turn, is sheltered by the hills above, flanked by its nicely-kept garden and shrubberies, and introduced by its pretty lawn, on which is a fountain fed by a perennial spring in the hills, the house looks out over the valley, with its brooklet, to the fields and hills on the other side.

The homestead is but half a mile from Ashbourne, and the Midland Railway Station lies midway between. It is a scattered occupation, comprising

* Some of the work is done by the piece, 10*s.* per acre being paid for cutting and heaping turnips, with 3*s.* 6*d.* more if soil is put over the heaps. Barley hoeing at about 5*s.* per acre, mangold hoeing and singling 8*s.* per acre.

	A.	R.	P.	
The Lodge	199	2	33	Owned by J. Harrison, Esq., Snelstone Hall, Ashbourne.
Booth's Pasture ..	23	3	0	
Ashbourne Green ..	36	1	23	Owned by G. H. Errington, Esq., Lexden Park, Surrey.
Wilson Farm	81	1	3	Owned by Lord Donington, Donington Park, Leicestershire.
The Meers	9	0	0	

Total, 350 acres; of which 224 acres are pasture, and 125 arable.

The Lodge Farm is described in the Certificate of Entry as brown loam with various subsoils, mostly gravel and clay. It is quite hilly, the arable land lying furthest from the house, and at the top of the hills. This makes it troublesome and costly to cart manure up and the crops down.

Crops.—This year there are 28 acres of corn, 15 green crops, 6 fallow, 41 hay, and 25 seeds. No particular course of cropping is followed. The grass-land about the house is suited for dairy purposes, but not for sheep in such seasons as 1879–80, for during the last winter Mr. Archer has, unfortunately, lost nearly 100 ewes, though the land had never been known to rot sheep before. Lime had been applied to some of the grass-land with very excellent effect.

Booth's Pasture and *Ashbourne Green* were well stocked with useful Shropshire sheep; altogether there were 305 sheep and lambs on the farms. Part of Ashbourne Green is used as a brick-yard, the bricks and drain-pipes being of excellent quality.

Cattle.—About twenty-five cows are milked at the Lodge. They are of a useful type, showing good milking properties, and they were giving a good quantity of milk at each inspection. The price obtained is 10*d.* per imperial gallon in winter (six months), and 8*d.* in summer (six months), delivered in London, and the carriage costs 1½*d.* per gallon. The milk is cooled in a special and effective manner by a refrigerator designed by Mr. Archer. It consists of a narrow trough, reaching from the cow-shed above to the milk-house below, a distance of sixty feet. The trough, which is placed by the side of a wall, is made of tin, and has a wooden lid with hinges, so that it can easily be opened and kept clean and sweet. Immediately below the trough is a flattened lead pipe, which conveys water from a hill-side spring down the length of the trough. At the upper end is a small tank, at the lower end the trough broadens out into a wide channel, and ends in a lip over a steel-tinned tank, 36 inches × 35 inches × 15 inches deep. The under-current of cold water is also spread out in like manner, so that the whole surface of the tin is cooled by water running below it. When a pail of milk is poured through the strainer into the upper recep-

tacle, then let out through a tap, it runs in a shallow stream the whole length of the trough, spreads over the wider end, and falls in a perfect little cascade over the lip into the tank, where it is measured and drawn off into the railway-churns. We tested the milk in the upper tank, and found its temperature 87°; by the time it was in the lower tank it was 42°. Not only in the refrigerator and the fountain has Mr. Archer shown his skill and ability to take advantage of Nature's provision, but from the clear ponds on the hill-side, which are abundantly stocked with delicious trout, for which Ashbourne is famed, he derives the power to cut chaff, grind corn, saw timber, &c.; also an excellent supply of good water for the cattle-troughs, which are conveniently placed around a yard near the comfortable cow-sheds. By the side of a barn there is an over-shot water-wheel covered with a wooden roof. To turn this, the water is brought under ground in an iron nine-inch pipe 168 feet long. When the pipe is near the wheel, it rises up like the traditional sea-serpent or the letter S, and discharges the water on the wheel, thus retaining all the advantage of the fall, without the unsightly and inconvenient over-head trunk. By this water-wheel an efficient corn-mill, a circular saw, which works very nicely, and a chaff-cutter, are worked. The latter has attached, in an ingenious manner, an endless self-acting band, which carries the chaff to the mixing-room as it is cut. Parallel with the barn where this machinery stands is a large wooden hay-barn with double bays, in which the whole of the corn and hay grown on the farm are placed. It is so arranged that after one bay is emptied, the steam threshing-machine may work under cover in any weather, corn and straw being all kept in the dry. There are some capital grains-cisterns, which could be filled with grains obtained from the brewery close by the farm.

Mr. Archer also manufactures for himself and his neighbours sulphate of ammonia of the highest quality from the gas liquor he gets at Ashbourne. Below the yards is a covered tank, into which all the liquid manure drains; a water-cart can be backed under and filled from a tap in a convenient manner. This is applied to the grass-land with good effect. All these fixtures and erections noticed, with many other permanent improvements, are the work of the present occupier. Another point deserves special notice. All manure is taken right away from the cow-sheds and other buildings, and placed in a yard where it cannot be a nuisance. This is a good example to dairy farmers, and especially to cheese-makers, for nothing is so easily affected by bad smells as milk, and an unpleasant odour will spoil cheese or butter.

Labour.—As in most farm-houses in Derbyshire, some of the

hands board and lodge in the house. Mr. Archer has three who do so—a waggoner, at 25*l.*, cow-man, at 20*l.*, and boy, 10*l.* per annum ; also a dairy-maid at 17*l.* To the shepherd he pays 18*s.* per week, and to a labourer 16*s.* The dairy-maid helps three others to milk.

Wilson Farm is in Leicestershire, near to Melbourne Station. There are 41 acres grass, and 48 arable. The land is moderately light, and has on it some fair crops of corn and roots. Most of the roofs of the buildings had fallen in, and none were replaced or repaired except those done by the tenant. The cow-sheds were particularly sweet and clean, and whitewashed, reflecting great credit on those in charge.

Fourteen ordinary Derbyshire cows were in milk here, the milk being fetched from the house morning and evening by a man, who gave 7½*d.* per gallon, and retailed it in the village. This is a kind of trade that might well be developed ; many villages are very badly supplied with milk. Would it not pay to retail and deliver it in considerable villages? It is the cheapest and most perfect form of food, and increased consumption of milk would be for the advantage of the workmen, their wives and children, and the farmer.

Mr. Arthur Milner, Stirthfield Farm.

First-Prize Small Dairy Farm.—Class II.

Stirthfield Farm is situated 17 miles north of Derby, about 4½ miles from Alfreton, 6 miles south of Chesterfield, and one mile from Claycross ; about half is in Shirland parish and about half in the parish of North Wingfield. Chesterfield market is generally attended, as Stretton station adjoins the farm, and the return fare to Chesterfield on Saturday (market day) is but 8*d.*, the Midland Railway Company in this, as in many other instances, showing their business tact in securing traffic by low fares and convenient arrangements. Claycross contains 3500 inhabitants, and is surrounded by large coal and iron works, in some of which the late George Stephenson, the father of railways, was greatly interested. No less than 3000 tons of coal are raised daily by the Claycross Company alone at their works. The shopkeepers of this place are supplied with butter, eggs, and cheese direct from the farmhouses in the neighbourhood and not from the market. The hills and dales of Derbyshire are widely known, and they well deserve to be, and here we are in the midst of them. The farm is bounded on the north by Ashover and Tibshelf road, and on the east by the

Derby and Chesterfield road; the Midland Railway runs up the valley through a portion of the land on the west. About half a mile from Stretton station, on the Derby turnpike road, on the top of the hill to the east, is one of the finest landscape views in Derbyshire. It is between Stretton and Higham, and includes in the area visible from this spot many places of historical interest. The best view is obtained from "Stubbing Hill." The scenery from this hill on a bright summer day is really magnificent. To the north-east, about five miles distant, Hardwick Hall, the seat of the Marquis of Hartington, may be seen. Alfreton, to the south-east, is four miles distant, but appears much nearer. Tradition says that Alfred the Great here concealed himself under a peasant's habit, and was rated by the wife of a neat-herd for allowing her cakes to be burnt; hence Alfreton from Alfred's-town. To the south, three miles away, stand the massive ruins of Wingfield Manor, where Mary Queen of Scots was confined at intervals for nine years. Crich Stand, a little more to the west, may be plainly seen; it is 955 feet above the level of the sea, and about two miles from the residence of one of England's noblest daughters, Miss Florence Nightingale. Matlock and Matlock Bath are only six miles from Stubbing Hill, but they are hidden behind a hill. Six miles to the north can be seen the town of Chesterfield, with its noted crooked church spire. At Stubbing Hill, as at Stretton, the Derby and Chesterfield turnpike road extends from south to north on the summit of the hill, whilst the Midland Railway extends in the same direction along the valley beneath. Beyond the railway, on the slope of the opposite hill, stands Ogston Hall, the beautiful residence of William Gladwin Turbutt, Esq., J.P.

The land in this district varies much in quality and fertility, one class being a dry and somewhat sandy soil, with gravelly subsoil; the other a heavy clay soil with clay subsoil and some blocks of grit-stone. The land in this locality, inclining towards the east from the top of the hill, consists of the better class of soil, as it lies in the same direction as the measures; this is much easier to work as arable land and much more productive than that of the heavy clay soil. That which inclines contrary to the measures, and especially that on the basset edge of the coal and ironstone beds, which abound in that neighbourhood, is of the poorest description of clay soil. It is most difficult to work as arable land, and only applicable to the growth of a certain class of crops. Unsuitable for the growth of roots,—wheat, oats, vetches, and seeds are the chief produce, but the greater portion is down in permanent pasture, for which it appears the best adapted. The uneven nature of the land and other evidences indicate that, at some time past, at least the top

coal has been worked. Those occupying the land adjoining Mr. Milner's farm have abandoned the cultivation of it as arable land, and, judging from the herbage in quality and quantity, the return must be very meagre. It is chiefly grazed by young stock, and appears to be managed much the same as a deer park. Much of this land no doubt would be benefited by draining. Scarcely any field is of one uniform quality, some parts have a fair quantity of soil, whilst in other parts there is little but clay. Those occupying the lighter soils are the more fortunate, as good crops of roots are produced upon them in addition to better crops of other produce. Unfortunately Mr. Milner occupies only some 12 acres of this lighter land; it is half a mile to the west of the homestead, and has the same dip as the underlying measures; half of it belongs to the occupier.

The chief product of the farm is cheese, of which a quantity of good quality is made, and sold as fast as it is ripe enough at about 8*d.* per lb., to be consumed in the neighbourhood; but during the winter butter only is made, and Miss Milner, on our first visit, showed us, with commendable pride, a basket of beautiful butter, made up and marked with a butter-print; the print in the market serving as a trade-mark, and from good makers the butter with "the cow" or "the thistle" on it is sought after, and an average price of 1*s.* 6*d.* per lb. is obtained. At the Royal Show at Derby this year Mr. Milner was awarded first prize for butter in the Maker's Class, and second in the Open Class.

When our latest inspection was made on July 8th, the cows were grazing in a field of nice grass and had no other food, their daily allowance of "dills" having been stopped so that they might produce the finest quality of butter; the sequel proved the correctness of Mr. Milner's judgment and Miss Milner's skill.

The farm consists of 87 acres:—42 arable, and 45 grass-land. It is owned by W. Gladwin Turbutt, Esq., J.P., of Ogston Hall, near Alfreton; and the occupier, Mr. Arthur Milner, succeeded his father in 1861. The farm has been occupied by the family about 50 years. The house is built of stone, is small and inconvenient; the buildings too are insufficient, some of the cow-sheds having a loft over, which the cows could nearly touch with their horns, but we were glad to learn that new premises are to be erected.

Tenure and Conditions.—This is a Lady-day take, and not under the Agricultural Holdings Act. A six-months notice to quit would be required, and the outgoing tenant would not be paid compensation for corn or meal consumed, but for cake, for draining done, and for hay and straw unconsumed. Most of

the land lies on the western slope of a hill, at the foot of which runs the Midland Railway; the house is near the Ashover and Tibshelf road, and the grass-land lies next the house, the more distant fields being arable. All this part is cold clay land, and requires much skill and industry to make it produce such crops as we saw.

Cropping and Crops.—The course usually followed is—

1. Oats on one ploughing.
2. Roots, or other green crop.
3. Wheat.
4. Seeds or green crop.

The tenant is not restricted as to cropping, but does as seems best to him. This year there are—

11 acres wheat.
10 ,, oats (Black Tartars).
10 ,, seeds.
5 ,, swedes.
3 ,, mangolds.
0½ ,, cabbage.
2½ ,, lints (vetches), and fallow.

Twelve pecks of wheat per acre were sown. The land is quite clean, and the crop promising. It had been top-dressed during the hard frost by spreading upon it night-soil brought from the neighbouring towns, costing nothing but the labour, and this had made an evident improvement in the colour and crop. The oats on the best land were a very fine promising plant, and forward. Four and a half bushels were drilled at twice, the rows crossing at right angles. Last year the oats and wheat were gathered without damage. Oats yielded eight quarters per acre on the best land, and between five and six on the clay land. Yellow globe mangolds and Hartley's short-top swedes of good quality were seen in December, and in May a fair plant of both were growing on the nicely ridged land. There were also a few Drumhead cabbages, potatoes, and winter vetches, here called "lints" or "dills." The small seeds sown on the wheat had come up very well, the quantities sown being, per acre—

3½ lbs. cowgrass,
3½ ,, alsyke clover,
2 ,, white clover,
1 ,, trefoil,
1½ pecks Italian rye-grass,
And some seeds out of hay.

The *grass-land*, like most other grass-land, has deteriorated

during the past wet seasons, but it is very well managed. One field is manured with the liquid manure from the yard, which is collected in a tank, pumped up, and applied from a water-cart, and seems to answer well. About 33*s.* 6*d.* per acre has been spent on *purchased food*, chiefly grains, maize, and rice-meal, and 8*s.* 7*d.* per acre on *purchased manures* in each of the past three years.

The *cattle* consist of 20 dairy cows, 1 bull, 5 stirks, 5 yearlings, and 7 rearing calves.

The *cows* were common hardy cows, of no particular breed or merit; but we were told they were good milkers. In May they were in low condition, though the quantity of meal generally given to them had been increased because the hay was bad in quality last year. In December they were eating pulped roots mixed with the chaff and rowen saved from threshing; 4 lbs. of maize-meal, with hay night and morning. In May, grass only.

There were two useful cart-horses and a colt. The working *horses* have 14 lbs. daily of oats and maize, and are employed to do work for hire when not needed on the farm.

Pigs are a considerable source of income. There were fifteen well-bred white pigs, and we were surprised when an old tumble-down door was removed to see walk out a handsome boar, the prize-winner at many local shows. The pigs are fed on whey and rice-meal, which Mr. Milner considers the best and cheapest food.

No sheep are kept, and most of the land is unsuitable for them.

The average cost of *labour* during the past three years has been 22*s.* 8*d.* per acre, but much work is done well and carefully by Mr. Milner's industrious son, Arthur Milner, who has been the winner of two cups at ploughing matches. A carter has 16*l.*, and a boy 8*l.*, a-year with board and lodging. A dairymaid at 12*l.* is also kept.

Most of the land was drained very efficiently by the present tenant when his father was the occupier. The drains are made of pipes, with loose stones placed on them, and are in perfect condition, though done forty years since. Mr. Milner considers that such land as his should be drained 4 yards apart and $2\frac{1}{2}$ feet deep to cure it. All the hedges are down and neatly trimmed. The gates are found by the tenant, and are in good repair. The accounts are kept in an accurate and careful manner, and a favourable balance-sheet could be shown even during these disastrous years.

Mr. Milner is an old competitor, and we saw eight cups, which were awarded by local societies for the best managed farm. He well deserved them, for he has won successful results

under adverse conditions. The Judges have pleasure in awarding to him the First Prize, and would recommend any occupier of bad land to go and see for themselves the satisfactory results of Mr. Milner's intelligent industry.

Mr. Samuel Woodward's Farm.

Class II.

Mr. Woodward's farm (Trusley, Etwall, Derby) is situated in a pleasant part of the pleasant county of Derby, and consists of 105 acres of heavy land, with a clay subsoil. It is the property of E. S. Coke, Esq., Debdale Hall, Mansfield, Notts.

There is one small field which had on it last year a few acres of "lints" ("dills" or vetches), and an acre or two of oats, and now has an excellent plant of most luxuriant red clover; with this exception all is grass-land, which lies scattered about in several lots. There was a considerable number of stacks of old hay standing at the corners of the fields, which Mr. Woodward told us were harvested in years in which he suffered great losses among his cattle. On several occasions he had lost a large part of his stock by pleuro-pneumonia, which had broken out among cattle he had bought in Dublin and other Irish markets.

The present tenant entered in 1861, following his father who had held it for 45 years. The house is after the pattern of many old-fashioned Derbyshire farmhouses, built more with regard to the requirements of the work than the comfort of the family; and now that cheese-making is neglected and milk-selling carried on, the cheese-rooms and dairy and back-kitchen, in which the cheese was made, have a rather desolate appearance, the empty cheese-presses and unused cheese-making apparatus giving them a weird look.

Mr. Woodward has made additions for the convenience of his milk trade, and has recently lined his grains-cisterns with good blue bricks laid in mortar, so that he may get in a store of grains during the summer months when they are cheap.

Tenure.—The farm is held under a yearly agreement, and is not under the Agricultural Holdings Act. The landlord is to pay for $\frac{1}{6}$th of the grains consumed during the last year of the tenancy.

The land-tax and tithes are heavy, the latter being about 5*s.* per acre.

Cattle.—At our latest inspection in May, 37 cows were in milk, and the milk was sent once a day to London, after being cooled in a refrigerator, made in Derby. The evening's milk

was placed in churns and allowed to stand in stone cisterns, filled with cold water, until morning, and then both meals were sent away. The contract price was 1*s.* 5*d.* per barn gallon (17 pints), for six months, and 1*s.* 10*d.* for six months. From this 2*d.* per "barn" must be deducted for carriage, which is paid by the sender.

Labour.—All the out-door work of the farm was done by the master and three labourers who lived in the house, the three receiving 25*l.*, 20*l.*, and 11*l.* respectively, and their board and lodging reckoned at 20*l.* per head per annum. The labour thus costing about 21*s.* an acre.

Purchased food.—In the winter the cows were feeding on hay, grains, and 4 lbs. of rice-meal per head per day.

Mr. Woodward has built several cowsheds, grubbed up hedges, and made other permanent improvements. The cow-shed would have been much better if more room had been allowed for the cows.

There were 10 horses of all sorts on the farm, though with the exception of taking milk to the station they had little to do, and must be considered as grazing stock.

There are no sheep or pigs on the farm, and no books are kept. Mr. Woodward appears to be a very hard-working, energetic man; but, as the Judges could not perceive any special merit in the farm, they declined to award a prize. A farmer who had, within the last few years, twice lost all his cattle from pleuro-pneumonia, and more recently had his sheep, about 200, cleared off by the rot, could hardly be expected to have his farm or his stock in a condition to successfully compete for prizes offered by the Royal Agricultural Society.

Mr. Francis Allen Price, Barnsheath, Appleby, Atherstone.

First-Prize Mixed or Arable Farm.—Class III.

Though this farm lies well together, it is in three parishes and two counties. The counties are Derby and Leicester, and the parishes, Measham, Appleby, and Snarestone. One end of the farm is near to Snarestone Station, and the other not far from Measham Station on the Ashby and Nuneaton Branch of the Midland Railway. It consists of 223 acres, 110 being pasture, and 113 arable, of stout red loam resting upon red sandstone. The property belongs to George Moore, Esq., Appleby Hall, and was entered March 25th, 1878.

Mr. Price is an improving tenant, and has strong faith in permanent improvements. He says, "I have made permanent

improvements, and permanent improvements have made me," and judging from those we saw at Barnsheath we should think the improvements he makes are real and judicious, but more hereafter.

The house is pleasantly situated; one side looking over a neatly kept lawn into a grass field, and the other into the yards. Below the lawn is a very nicely kept kitchen-garden, where all kinds of crops thrive, and weeds hide their diminished heads. Here we saw some specially substantial kidney-bean sticks—iron hurdles set on end and decorated with scarlet-runners, whilst their fellows were piled up in inglorious idleness awaiting the winter-folding of sheep. The lambing-yard has been specially arranged, so that the master can look into it from his bedroom. Mr. F. A. Price lives at Barwell, and his son, Mr. John Price, manages this farm in a most industrious and praiseworthy manner. A large fold-yard, paved with blue bricks, is next the lambing-yard, and has round it the cowsheds on two sides, with a three-horse engine pulper, chaff-cutter, corn-mill (Derbyshire stones), steaming apparatus and mixing-room in the corner, and on the fourth side are horse-boxes and stables. The chaff-cutting and pulping-room adjoin the stack-yard.

Tenure.—This farm is not under the Agricultural Holdings Act, but a code of allowances is agreed upon between landlord and tenant, by which an outgoing tenant can claim for unexhausted improvements, and be sued for dilapidations, foul land, &c. Three cottages are taken with the farm, and are let to labourers.

Course of Cropping.—Mr. Price seems to have fixed on a course of cropping, to which he sticks in a very stiff-backed fashion, and if this year's crops are a fair sample he had better do so. The course occupies eight years, and is as follows:—

Seeds.	Beans or green crop.
Second seeds.	Wheat.
Oats.	Fallow or roots.
Wheat.	Barley.

This 8-course shift is adopted so that a full plant of clover may be secured when seeded down to lie two years. The seeding is done very carefully, as indeed every operation seems to be. A mixture of many varieties of clover is made: 14 lbs. of clover and 1 peck of Pacey's rye-grass, and some rib or Timothy-grass are sown on each acre. They are sown at twice, lengthways and crossways, as soon as the barley is up, and horseraked in. This practice has been adopted for many years with great success.

After the clover is mown for hay, the second growth and

the second year's lay are grazed, chiefly with sheep, which consume on it corn and cake, and in the winter roots. The arable land is too strong for folding sheep upon in winter, so roots are drawn into the second seeds, made into heaps and well covered, and then eaten, with corn and cake, in folds by the sheep.

The land is then ploughed up with a thin and flat furrow, sown broadcast, with 3 bushels Poland oats, and then drilled across with the same quantity. After oats comes wheat, for which the land in any but the wettest season receives 2 tons per acre of quick-lime. Beans follow the wheat, the land being manured and drilled at the end of October or beginning of November; the rows are placed 18 inches apart, so that they can be horse-hoed. Wheat is taken after beans, then comes fallow for roots. Yard-manure at the rate of 15 tons per acre, with 3 cwts. Peruvian guano, and 4 cwts. salt are applied. Roots are drawn off, and land ploughed for barley and seeded.

Crops this year are—

22 acres wheat after oats and beans.
22 ,, barley after roots.
15 ,, oats after second seeds.
7 ,, winter beans after wheat.
16 ,, roots.
16 ,, young seeds.
12 ,, second seeds.

Wheat.—The varieties grown are Square-head and Boston stump, both fields were perfectly clean, and had nice level crops with excellent ears. The wheat had been sown broadcast.

Barley.—This can scarcely be called barley-land proper, and yet one might go many miles any way to find two such grand, full, level fields of barley; though very strong and luxuriant, the owner protested against the suspicion that any top-dressing had been used.

Oats.—This is a bad year for oats, but Mr. Price's oats have grown in happy ignorance of the fact. They were thick and strong, so that they resisted the foot, and tapped on the ankle as one pressed a way through them; acres of them were as high as a man's shoulders. Mr. Price, jun., had ploughed the land and sowed them himself, and they could not be more regular. One thistle was the only weed we saw in the 15 acres.

Beans had been injured by the severe weather, and were best on the sheltered side of the field; they were short but well corned. They had been horse-hoed, and four times hand-hoed. The soil was nice and loose, though a few small thistles struggled into sight where beans were thinnest.

Roots.—By the side of the beans were some turnips sown in May on very nicely struck ridges, but before our July visit the fly had taken them, and a second crop was growing apace, the land having been re-ridged. Mangolds had suffered very badly from mangold-fly maggot, but would get into a crop. A patch of carrots, and another of potatoes, looked very well, but a few cabbages had a maggot at the root that was doing mischief.

Seeds.—An excellent crop of clover had grown on one field, part of it was in stack, and part was being mown in July, a full heavy crop; another field was the pasture of some sheep, and was full of white and Alsyke clovers.

Grass-land.—All of this, 110 acres, excepting a bit of low, rough, undrainable land by a brook, gave evidence of care and skill in its management; the quality of the grasses, the abundance of herbage, the absence of hassocks and weeds caused every acre to carry its own credentials. Mr. Price says that draining, bones, and sheep have done it, and he, probably, is right.

Cattle.

In *December.*	In *May.*	In *July.*
1 Cow in milk.	6 Cows in milk.	6 Cows in milk.
28 Feeders.	10 3-year-old steers.	10 3-year-old steers, feeding.
10 2-year-old steers.	16 2-year-old stirks.	17 2-year-old steers „
31 Yearlings.	17 2-year-old steers.	21 2-year-old heifers.
15 Calves.	15 Yearlings.	12 Yearlings.
	11 Calves.	11 Calves.
85	75	77

Dairy cows are here in a minority, and are only kept to rear calves, which Mr. Price, sen., breeds, and sells to this farm at 25*s.* to 30*s.* a-head. About ten at a time seem to be reared; we found them in the lambing-yard, which was dry and nicely littered, they had a shed to run under, and plenty of clean water to drink. On 1 quart of milk morning and evening, and plenty of green clover, they seemed to be doing very well. All calves get 1 lb. of cake a-day until they are a year old, then no cake until they are put to feed.

Feeding-cattle.—In summer these get 3 lbs. of linseed-cake a-day each, and in winter, when they are in the sheds, they each have daily 4 lbs. linseed cake, 4 lbs. barley-meal, and other corn mixed, with steamed cut chaff, pulped roots and hay. These are about the maximum quantities of corn and cake, sometimes a smaller quantity is given. The feeding cattle we saw in December and in July were good animals, well bred and full of growth; two of those we saw in December were specially good beasts; grand frames and beautiful quality, doing equal credit to breeder and feeder.

Sheep.—Mr. Price has very strong faith in Shropshires. He says he has "tried Leicesters, Lincolns, Cotswolds, and Oxford Downs, but Shropshires are the most rent-paying class of sheep for this locality." He has had rams from Messrs. German, Masfen, Baker, and Coxon, but the ewes are home-bred. In December the tegs were within hurdles on the second seeds, eating swedes and cake. These were sold in February and March, out of the wool, at 9*d.* a lb., making an average of 60*s.* per head.

In *December.*	In *May.*	In *July.*
40 Ewes.	66 Ewes.	65 Ewes.
88 Grazing sheep.	113 Lambs.	113 Lambs.
101 Tegs.	27 Ewe tegs.	27 Ewe tegs.
	5 Rams.	5 Rams.
229	211	210

The fat sheep and tegs get a mixture of cake and corn, $\frac{3}{4}$ lb. to $1\frac{1}{2}$ lb. per head per day, with roots during winter. Ewes run upon grass-land and get a little chop and ground oats before they commence to lamb; ewes with twins receive a little artificial food till the lambs are weaned, and if requisite those with single lambs also. The lambs are weaned by the middle of July, and have $\frac{1}{2}$ lb. of corn and cake a-head per day. Ewes are then examined, about one-third of the ewe flock is culled out and at once put to feed without allowing them to sink, the flock being again made up by ewe tegs. Only one sheep was lost between December and July, and not any from rot. Altogether they are a fine, healthy, good lot of sheep, such as any farmer may be proud of. The ewes reared a splendid crop of lambs, 113 with 65 ewes, and the Leicestershire Agricultural Society awarded to Mr. Price the first prize in short-woolled classes for rearing, with smallest loss of ewes, the largest number of lambs. There were about a dozen entries. We hope Mr. Price, jun., holds the prize, for it was won through his attention.

Horses.—Five valuable cart-horses are kept. In July they had got through their term, and were enjoying a recess out in a grass-field. Grass only is their food when they do no work; in winter they have daily 6 lbs. oats per head with swedes and hay *ad lib.* There were also one strong foal and two young horses.

Poultry.—In the accounts we noticed that the sum of 35*l.* 13*s.* 9*d.* was placed to the credit of this department.

Labour.—Considering the extent of the arable land and the admirable way in which everything is done, 25*s.* 6*d.* per acre is a low figure for the cost of labour, but then Mr. Price, jun.,

does not reckon his labour at anything, and we do not know how many men he is worth.

Four labourers are kept—
Cowman at 17*s*. a week and cottage.
Shepherd „ 15*s*. „ „
Labourer „ 15*s*. „ and no cottage.
„ „ 14*s*. „ and cottage.

Carter in the house at	.. £12 0*s*. +	board and lodgings ..	£26
Boy „	.. £ 4 10*s*. +	„ „ ..	£26

To the labourers' wages 40*s*. are added for 10 weeks harvest wages instead of food or drink. The hours of work are from six to six with half an hour out for breakfast and one hour for dinner, but in harvest they only take the time occupied in eating their meals, no extra hands are put on, each man is expected to harvest 12 acres of a good crop. In the winter a man and a strong lad attend to the 80 cattle, one day they are occupied in preparing the food, getting in roots and fodder, and next day they work the engine, pulping, cutting, grinding, and steaming what is needed for the four feeds given them daily.

Feeding-stuffs and Manure.—The sum of 35*s*. 8*d*. per acre was spent last year on these items, the larger part, 33*s*. 6*d*., being wisely spent on purchased food.

Accounts were carefully and accurately kept by Mr. Price, jun., with a valuation and balance-sheet made up to March 25th in each year in a proper manner.

Fences.—The fences are good, the gates being in good repair and painted; between the grass and cornfields the gates were nailed and drawn with thorns so that we had difficulty in getting into a field or out of it. There is not much timber on the plough-land, which is a great advantage, for no one can keep good fences or grow good crops under trees. The landlord finds material for repairs.

Improvements.—The road to the house from the public road has been made by the tenant at his own cost, and is three-quarters of a mile long. The large fold-yard is very unlike many yards, it is level and paved with blue bricks. When Mr. Price became tenant the yard was hollow and dirty, stagnant water lay in it or found its way into the well, which, as is usual, stands between the yard and the back door. The cattle used to be turned out for water into the grass-fields, and they trod the turf into a quagmire for some distance; now, one may walk about inside the yard or out, without inconvenience. Mr. Price did not approve of the quagmire nor of the spoiled water of the well, for it could not be used; nor the inconvenience and loss attendant on the men going round the yard, or across it, treading the cowdung into the food on the mixing-floors. He, therefore,

cast about for a remedy and found an excellent one; there was an old marl-pit 500 yards away, there was always water in it, and a big piece of land measured into the farm could not be cultivated,—it was a quagmire too. Could not this surplus of water be made to neutralise the want of water and both quagmires be abolished? It was done. Troughs 18 inches deep, specially designed by Mr. Price, were built into a wall erected between the large yard and the lambing-yard, a pipe was also built *in* the wall at the bottom of the troughs, so that abundant motion of the water would prevent freezing and destruction of the troughs. A pipe-drain was then carried the 500 yards up to and under the marl-pit. This was a costly job, for much of it is 14 feet deep;—11 feet rock, and 3 feet loam. The landlord found pipes, troughs, and bricks, and built the wall dividing the yards, also paid half the cost of the cutting of the drain. It has all answered well, the pump water is good and sweet, the yard is clean and neat, there has always been an abundant supply of water, and now in the marl-pit there is growing a splendid crop of potatoes. About 70 acres Mr. Price has drained (his landlord finding pipes) at distances and depths varying from 7 to 20 yards wide, from 5 feet to 3 feet 6 inches deep, according to the nature of the subsoils. In the accounts all these improvements are charged with 5 per cent. interest. There is also a charge of $7\frac{1}{2}$ per cent. on bones applied to grass-land. They were $\frac{1}{2}$-inch, boiled, kitchen bones, and 7 cwts. per acre were applied. The meadows had the hassocks cut off them, and a novel way of disposal was adopted; they were spread on a piece of strong land and ploughed in, getting rid of the hassocks and benefiting the land.

Mr. Price holds theories, and they hold water, or he would not hold them. It is very pleasant to go over a farm so well managed, in so systematic a manner. Mr. Price, jun., intends to give up grazing and rearing so many cattle, and take to dairying and milk-selling. We do not doubt he will then have more pleasure in making up his balance-sheets.

In the inch-by-inch contest in this class Mr. Price wins a well-deserved First Prize.

Mr. Edward George Rossell's Farm.

Second Prize.—Class III.

The farmhouse known as New Farm, Stapleford, is within a mile of Sandiacre station on the Erewash Valley branch of

the Midland Railway, and can be readily seen by looking eastward from the railway when between Toton and Sandiacre. It was built by the late Mr. W. Harrison, a much-respected miller of Nottingham, for his own private residence, but unfortunately he died and never fully occupied it. It is a comfortable and convenient house, pleasantly situated on a hill-side overlooking the valley of the river Erewash, and across to the ruins of Dale Abbey and the village of Stanton-by-Dale. The villages of Stapleford and Sandiacre have a numerous population, who are employed at some of the silk, lace, hosiery, or starch factories, or in railway-carriage or iron-works; and among these Mr. Rossell finds a market for some of his milk. Busy and prosperous Nottingham, with its lace and hosiery trades, its beautiful University Buildings, its castle (now an art museum), its interesting history, and its 188,035 inhabitants, is six miles distant, and is the market town.

The tenant has several pieces of land in addition to the home farm, the particulars of which we copy from the certificate of entry:—

Owners.

Mrs. Harrison, Radford, Nottingham .. (Entered 1878.)	141 a. = 70 arable and 71 grass
Mrs. Hodgkinson, Chesterfield .. .. (Entered 1880.)	28 ,,
Rev. D. Smith, Sandiacre .. .. (Entered 1878.)	14 ,,
Mr. Evans, Sutton-Coldfield .. .. (Given up March, 1881.)	13½ ,,

Being a total of 196½ acres of moderately strong land over a clay subsoil. The 28-acre lot of grass-land lies near the Trent at Attenborough; some of it has frequently been flooded in the past winter, and is used only for grazing cattle and young horses.

There is stabling for 6 horses and standings for 32 cows, with a fair supply of other sheds, yards, and buildings, though more would be useful where so many cattle are kept.

Cottages.—There are two cottages, but they are not included in the rent of the farm, but are taken separately at a rent of 14*l.*, and re-let on the same terms to labourers.

Tenure.—The tenant is not under the Agricultural Holdings Act, but has a yearly agreement with allowances to the outgoing tenant for unexhausted improvements in accordance with the Nottinghamshire custom, such as ¼th of cost and carriage of cake used during the last year of the tenancy, and ⅛th of that used in the previous year; also payment for all "orders" (acts of husbandry), rent, and rates on root-land; but where the

roots have been removed deducting the full value of such roots. Payment would also be made to the outgoing tenant for manure at its value, and away-going price for straw, &c.

Cropping.—The usual course of cropping followed is roots, barley, seeds, wheat, beans, wheat. The seeds may lie one or two years. Fourteen acres are glebe-land; of this a 10½-acre piece was seeded down four years ago, and has not been ploughed since; it was sown with seeds to lie two years, and as the seeds seemed to do well other seeds were sown; the field was dressed with lime and soil, and now there is a good sward with abundance of white clover. The other 3½ acres were seeded with permanent seeds, and have a better plant than the 10½ acres. This land is evidently much more valuable as pasture. It might have been better if the 3½-acre lot had been laid down level, as the other field is, instead of being in lands; as furrows are liable to grow rushes, and tops of lands to burn; besides, furrows are always dangerous to sheep.

Crops.—The acreage of the different crops on the farm are

Wheat,	20	acres.
Oats,	7½	,,
Barley,	9	,,
Beans (winter),	10½	,,
Mangolds,	2½	,,
Potatoes and turnips,	4	,,
Cabbage,	1½	,,
Seeds,	13	,,

The quantities of seed sown per acre were

Wheat, 2½ bushels, early, and 3 bushels later.

Barley,	2½	bushels.
Oats,	4	,,
Beans,	3	,,

Wheat.—The wheat is Hunter's white, and though one field, after beans, would have looked better if there had been no squitch in it—and last summer was a bad one to clean such land—it looked very well in July, and one field is probably the best we have seen this year—a full plant, tall and well headed; it looks like quite six quarters per acre. Last year Mr. Rossell never stacked it, but threshed it in the field and sold it for seed, and he may do so again. This was after mustard, grown on pin-fallow (seeds ploughed and worked), the mustard ploughed in.

Barley.—That after the mangolds is a very nice crop, though not strong enough in the straw to bear much rough weather. With good weather Mr. Rossell will get a lot of nice barley.

Oats.—Oats are growing where seeds should have been, but they were not good enough to stand. Some Black Tartars

promise a good crop, but some costly seed from a well-known seed firm did not come up half thick enough.

Beans.—Mr. Rossell is growing winter beans, and the severe winter has much injured them, especially where the snow drifted and left the land bare on that terrible 18th of January. However, they are well kidded, though short, and will no doubt thresh well. They were drilled 22 inches apart, and have been several times horse-hoed and hand-hoed, and just before the last hoeing were sown with rape, which had come up well at our last inspection. There was an excellent sample of old beans in the granary, some of which had been sold at 48*s.* per quarter.

Roots.—About 2½ acres of yellow globe mangolds were very good indeed, and gave every promise of being a heavy crop, though the maggots of the mangold-fly had done much mischief to them. Part of the seed had been supplied by Webb and part by Carter, but we could not see which was best at our last visit. The swedes had given Mr. Rossell much anxiety, for the turnip-beetle attacked them in a very determined manner ; and with equal determination Mr. Rossell defended them by drawing over them elder boughs, horse-hoeing with elder boughs tied to the sides of horse-hoe, rolling, sprinkling with diluted paraffin, and finally with fresh slaked lime. This was too much for the beetles, and Mr. Rossell was victorious, as he deserved to be, for he had been at them as early as 3 A.M. and as late as 10 P.M. They were in July a vigorous plant, though a little irregular in the rows. As on most well-managed dairy farms, there was a patch of Drumhead cabbages, which were doing very well.

Seeds.—The mixture of seeds sown by Mr. Rossell is 10 lbs. red clover, 2 lbs. white clover, 2 lbs. trefoil, and half a gallon of Italian rye-grass.

There are 13 acres of very good clover ; on part of it 3 cwts. per acre of soot had been sown, which had the effect of doubling the crop. This was an excellent investment.

At our last visit a very good stack of capital fodder was secured from the seed-field as well as 15 acres of excellent meadow hay. Mr. Rossell estimates the average produce of his clover at 40 cwts. per acre, and his meadow grass at 32 cwts. to 35 cwt.

Grass Land.—In May a few thistles were growing, but in July all the grass-land was well looked after, and, excepting the outlying land by the Trent, which has so strong a tendency to get rough in wet seasons, was not only free from weeds, but full of fine grasses and clovers. Want of good water is a serious defect in several grass-fields, and difficult to be remedied.

Cattle.—The numbers on the farm we give below:—

December.	*May.*	*July.*
21 Cows in milk.	20 Cows in milk.	22 Milkers.
8 Cows in calf.	6 Cows in calf.	24 Feeders.
3 „ barren.	24 Cattle feeding.	1 Stirk, barren.
14 Feeding steers.	4 Heifers in calf.	10 In-calvers.
5 Heifers.	1 Stirk, barren.	3 Yearlings.
6 Yearlings.	3 Yearlings,	9 Calves.
5 Calves.	9 Calves.	3 Bulls.
3 Bulls.	3 Bulls.	
65	70	72

Dairy-cows.—The usual number of cows milked is twenty. They are mostly bought, and are good ordinary Derbyshire Shorthorns, selected with regard to their milking and feeding properties; for if one does not milk properly, or loses a quarter, she is made into beef, and another put into her place. This increases the amount received from the butcher, but it also increases the outlay for cattle and for feeding-stuffs. The average quantity of milk sold in the past year was 43 imperial gallons per day, and when we were there in May and July, the cows were giving about 46 gallons; they were then having 2 lbs. of linseed-cake a day. In the winter each cow had daily a mixture of 3 lbs. cake (linseed and cotton), 5 lbs. bran, 5 pecks grains, 14 lbs. roots, with cut chaff, and night and morning a little hay. The feeding cattle had 7 lbs. mixed cake, 3 lbs. barley-meal, $\frac{1}{2}$ cwt. roots, with chaff and hay. The heifers and in-calvers were out at grass in the day, and had hay in the yards at night; the calves had 1 lb. of cake apiece, in addition to their hay.

Feeding-cattle.—In December, fourteen good heifers and steers were in the sheds being finished off; a first lot had been grass-fed, and these had followed them in the pastures. In May these were gone, and others were in the pastures; in July some of these latter were fat, and ready for the butcher. About six *calves* are reared yearly. They have two gallons of milk a day for eight weeks, and then linseed-cake gruel is given, the change of food being gradual. Rearing-calves are not turned out till they are twelve to sixteen months old. Spring-reared calves would not go out the first summer. Mr. Rossell says, by giving them green clover, &c., he can keep them for smaller cost than if they were turned into the fields, and there is no danger from worm in the throat—that fruitful cause of weakness and mortality among calves.

No *sheep* are now kept. Some have been kept up to last autumn, when all were sold through fear of fluke.

One sow of the large white breed is kept, her progeny being sold, except what is required for home use.

Horses.—Three good cart-horses do the work of the farm. One of them is a well-bred mare, which is entered in the 'English Cart-Horse Stud-Book.' In July she had a capital filly-foal by 'Warrior,' running with her. There are also kept a nag and a milk-pony. The winter allowance of corn for a cart-horse is 10 lbs. daily of maize, oats, and bran, mixed with ½ lb. of linseed-cake and cut chaff.

Two foals are generally reared, and we saw one two-year-old and two yearling colts; all of them useful, and one yearling is a specially good colt.

Poultry.—This is in Mrs. Rossell's department, and, like the rest of her charges, well looked after, and it should be, for it is expected to "keep the house."

Implements.—Among a suitable assortment of implements, which are clean, and put under cover in a good cart-shed, is a good corn-drill, with steerage horse-hoe, by Coultas, a self-delivery reaper by Hornsby, and a Bamlett's mower, which has cut the grass in a very satisfactory manner.

Labour.—One labourer, at 17*s.* per week, and his cottage (3*s.*), and a cow-man, at 17*s.*, and his cottage, with a boy at 4*s.* per week, supplement the work of three others, who board and lodge in the house, and receive respectively 16*l.* 10*s.*, 11*l.*, and 6*l.* a year. A little work is done by the piece, such as cutting off and putting in heaps turnips at 9*s.*, and mangolds at 10*s.*, per acre. The total average annual cost of labour for three years, including board and lodging, has been 21*s.* 7*d.* per acre, exclusive of work done by the master, who takes a full share. Three or four hands do the milking, with Mr. Rossell's assistance.

Feeding-stuffs and Manures.—The average cost per annum for three years has been about 27*s.* 9*d.* per acre, 26*s.* 3*d.* being for feeding-stuffs. Part of the purchased manure was night-soil, which is very effective on the stronger arable land, but does not cost much (9*d.* a load), except for labour.

Fences of quick were strong, and kept within bounds. All the gates and posts had been painted with gas-tar at 4*d.* each, the tenant finding the tar. There was quite enough timber growing in the hedges, mostly good ash and elm.

Milk.—This is one of the chief items of income, this and fat stock. One contract is for 105 imperial gallons per week, fetched away at 9½*d.* per gallon; this is retailed in the adjoining villages. Another contract is for 199 gallons a week at 10*d.*, for eight months, and 9*d.* for four months, delivered in Not-

tingham. Mr. Rossell finds churns, puts the milk on the rail twice daily at Sandiacre, and pays ½*d.* per gallon carriage.

Accounts.—These and a diary are well and carefully kept, and have been for ten years.* The stock is valued, and a balance properly struck each year on April 6th, Old Lady Day, the common time of entry in this district.

Although the entries in this class are limited, the competition is keen, and Mr. Rossell comes in a very good second, the general management of the farm being highly commendable, and the financial results very satisfactory, forming a good illustration of industry, shrewdness, and economy.

XXX.—*Report on Cheese-making in Derbyshire.* By GEORGE GIBBONS, Tunley Farm, near Bath.

THE Judges went to Derbyshire expecting to find the manufacture of cheese a very important feature in the farms competing for the prizes offered by the Royal Agricultural Society, especially as only two of the entries were made in the Arable Class; but to their surprise they only found cheese made regularly on two of them, viz., on the off "Nothill" farm of the late Mr. W. T. Carrington, on the small farm of Mr. Milner, of Alfreton, and occasionally on some of the other farms, when the supply of milk is greater than the requirements of the trade. Not long since Derbyshire cheese was made throughout the county in large quantities, and realised remunerative prices, but within the last twenty years a complete revolution has taken place in its dairy husbandry. There are still the fine herds of capital, roomy, massive Shorthorns, with plenty of flesh and hair, and above all yielding milk in such profusion that would make many a high breeder disgusted with his own stock; and of many of the competitors it may be truly said—

> "His kine with swelling udders ready stand,
> And lowing for the pail invite the milkers' hand."

Few of these animals can boast of any pedigree save that of being descended from heavy milkers, and having for their sire a bull selected for a similar reason.

The room, outside of whose windows some thirty years since was a board, on which were the words "Dairy Room" conspicuously placed to show that it was thus exempt from window-tax, is now tenanted simply by a plaything of a milk-pan to raise a little cream for the family. The cheese-tubs, many of

---

* Mr. Rossell kept the accounts when with his father before he was sole tenant.

them copper, with their appliances, must have been expensive articles, but are now lying in an outhouse, and probably filled with corn or meal. The cheese-presses are merely lumber, and some of them would have found a very appropriate place in the "ancient implement-shed" at Kilburn, and not have been wished back again. Cheese-vats used as feeding-troughs or flower-pots; whey-tanks dry and dusty; pigstyes without inhabitants; the time-honoured occupation of the dairy-maid a thing of the past; and from the best authority it is found that only one-half to two-thirds of the cheese made in the county twenty years ago, is now produced. But in passing over the district, as the judges did by the early morning trains, they found at nearly every station numbers of carts unloading milk to be forwarded to London, Liverpool, Birmingham, and other large towns. Whence the change? It did not appear that there were any special advantages either in facilities of transit, or in the prices given for the milk, as the large bulk of it was sent to London, distant 130 miles, and 2*d.* per barn gallon, being fully $12\frac{1}{2}$ per cent. of its value at Paddington, charged for its conveyance there, nor was it found that the milk was of any richer quality than elsewhere. The probability is that several causes are mainly responsible for the change. One would be that the Derbyshire system of cheese-making entails a great amount of extra and laborious work in its manufacture compared with some others, and of which all concerned in it would gladly be quit, particularly the wife, on whom the largest portion often fell, as she was thus enabled to add materially to the well-being and comfort of the household. Foreign competition has doubtless been a very prominent cause. Messrs. Etches and Co., the well-known cheese-factors of Derby, say respecting this:—"The constantly increasing importation of foreign, the great improvement in its manufacture, the consequent lowering effect on our home-made, the scarcity of good makers here, the high prices offered at the outset by milk-dealers, are amongst the chief causes of the alteration, which has been far more rapid in the last ten years than in the previous decade." The weekly payment for milk has doubtless not been overlooked in comparison with the distant but lumpy receipts for cheese. There is, however, one considerable advantage that producers of milk enjoy in this county, viz., their proximity to the vast breweries of Allsopp, Bass, and others, at Burton, of world-wide fame; from these breweries, immense quantities of grains are turned out daily, and can be obtained to almost any extent at about 2*d.* per bushel during the late spring and summer months. These, if well trodden into tanks, will keep sweet and good for twelve months, and it was nothing unusual to find from 10,000 to 12,000

bushels thus put away on some farms. There is no doubt that brewers' grains make a most excellent food for milch cows, either given by themselves or mixed with meal, chaff, &c., and that thus the farmers are enabled to guarantee good supplies of milk in the winter, when it is of so much higher value than in the summer months.

Of course, whether the 7*d.* per 8 pints, which, after the payment for carriage, is about the sum returned to the producer from the 1st of April to September, is the most that can be made of it, is a very interesting and important question. Taking the figures given in the valuable paper on 'Dairy-farming,' by Mr. J. C. Morton, published in No. 28 of this 'Journal,'* we find that 21 pints of milk = $2\frac{5}{8}$ gallons, will make 1 lb. of butter, which, if well made, would, on the average of years during those months, be worth at least 1*s.* 3*d.*, there would then be left 2 gallons of skimmed milk, worth, either to make into cheese (and sold when three weeks old), 3*d.* per gallon; for fattening pigs or rearing calves, or certainly to sell as a most wholesome and nutritious beverage, 3*d.* to 4*d.* per gallon. The above 2 gallons of whey (and buttermilk) should, if cheese is made of it, be worth 1*d.* for mixing with meal for pigs, making thus for the products of the $2\frac{1}{2}$ gallons 1*s.* 10*d.*, being fully $8\frac{1}{4}$*d.* per gallon.

If made into fine Cheddar cheese, and taking 10 gallons for the production of 9 lbs. of it when ripe, worth say 77*s.* per 112 lbs., and placing a value of 1*d.* per gallon for the whey and manure made from it, a similar return of $8\frac{1}{4}$*d.* per gallon is secured. Against the expenses connected with the butter or cheese-making, there is the cost of sending milk twice daily to the station, which, if $2\frac{1}{2}$ miles distant, making 10 miles daily, would be nearly one horse's work; this, with the wear and tear of the churns, caused mainly by the careless way they are handled on the railway platforms, would be a full equivalent.

In the immediate vicinity of large populations, where the morning's and evening's milk can be supplied hot from the cow to the consumer, at the minimum expense of carriage, the sale of milk at 1*s.* per gallon is by far the most profitable mode of disposal. Towns are as yet much better supplied than rural districts. This is now being remedied, and the milk-cart taking its daily rounds is very common in our villages; the retailer gives 8*d.* per gallon, and delivers it at 3*d.* per quart in quantities as required.

The immense extension of the trade in milk during the last few years is a source of great congratulation; it is known to

---

* Second Series, vol. xiv. Part II., 1878, p. 647.

be the best beverage that can be given to children, and the fact that it is used in our hospitals extensively, with just a dash of rum, is sufficient excuse for saying, that those not in hospitals would find it thus treated a most pleasant and nourishing drink to commence the day with. The enforcement of the Adulteration Act has been an enormous boon to the honest milk-seller. Consumers know that they get a genuine article, and consequently buy it freely; and it is not now possible to convert 10 gallons into 15 as was formerly too often the case. The consumption will yearly be greater, and may be considerably increased by its use in the making of bread, which it very much improves. In many places whey can be advantageously used as a substitute, which has been done for some years in my own family.

Whether milk be sold, or used for cheese, butter, or bread-making, it is imperative that the greatest cleanliness be observed in its production. The water the cows drink should be pure, and their access to ponds containing sewage matter from the yards strictly guarded against. The cow-houses and yards should be kept as free from manure as possible, as it is surprising how soon contamination takes place in milk by impure air. Before the milking commences, the udders and teats should be well washed; and where any number of milkers are employed, the cows should be carefully stripped by a reliable person at every milking.

Any report on cheese-making in Derbyshire would be incomplete, were no reference made to the factories established there some years since for its manufacture on a wholesale co-operative principle. They were fully described in this 'Journal' by Mr. J. C. Morton, in his paper on 'Dairy-farming,' from which I have already quoted; and the depression that has so weighed on British agriculture has extended to them, resulting in a decrease in their number. An undoubted authority, in reply to my inquiries respecting them, says:—"Their success has been various; they have made good, bad, and fine cheese, just as farmers are now doing at home, according as they have a good or bad maker. With the exception of one or two of them, they all sell milk whenever they find it advantageous. Fine home-made cheese is preferred; but there is so little really fine, that best American takes its place in many districts."

The process of cheese-making varies with the different seasons of the year, doubtless the one in operation during the summer is the most valuable, and I will therefore now give it as seen on the "Nothill" farm of the late Mr. W. T. Carrington, where Derbyshire cheese has been made for many years. This farm is very inconveniently situated, its approach being through fields that in wet winter months must be nearly impassable. The soil is mostly heavy, and of an inferior description, and although drained, yet the past wet seasons have much injured it. The

capital dairy of some forty Shorthorns showed at once that they were indebted to other than home resources for their fine condition and large yield of milk. Mr. Carrington's practice of feeding them daily with 3 to 4 lbs. of decorticated cotton-cake has been attended with the best results to the cattle, besides adding much to the fertility of the farm. "Bamford's Cheese-making Machine" is used in this dairy, and proves a source of considerable economy both in time and labour. The milk made up at the July inspection consisted of about 100 gallons, the produce of the morning's and evening's milkings. When heated to 84 degrees, the rennet is added, and the mass stirred some time, it being most essential to thoroughly mix it with the milk. One hour is allowed for coagulation, when the breaking-up of the curd commences. This is done by an implement in the shape of a sieve, with wires placed crossways over the bottom of it. The greatest care is taken in this most important operation, the weight of the breaker being almost sufficient to sink it to the bottom of the tub, whence it is raised by a handle fastened perpendicularly on its centre. After the whole mass has been thus treated, the breaking goes on more rapidly; the object aimed at is to keep the whey as green as possible. At the expiration of about forty-five minutes, when the curd is broken into pieces about the size of peas, it is allowed to settle a short time, and is then gathered by a small shovel into the centre of the tub. The whey, when quite clear, is let off by a tap placed in the side of the tub, about one-third from the top. A stout, well-protected, tin-plated follower, thickly perforated with holes about the size of common shot and made to fit the interior of the tub, is now placed in it, and sinks by its own weight on the curd; the whey runs off by another tap fixed on the bottom of the tub. The follower or sinker, which can be easily raised or lowered by means of a most convenient apparatus, connected with the machine mentioned above, is then lifted, the curd cut with a knife about a foot from the sides of the tub, and again collected in the centre (the whey constantly running off), and the sinker lowered, on which considerable pressure is applied by a screw, forming also a part of the machine. This operation is repeated continuously eight or ten times, until the curd is fairly dry, necessarily occupying considerable time and almost incessant attention. The curd is then ground in a mill, also made by Bamford, through which it passes twice; fine cheese-salt is mixed with the curd in the proportion of 1 oz. to 6 lbs.; and 40 lbs. are made into one cheese. After being in the press for an hour, it is taken from the vat and placed in hot water at 150° for a minute; this is termed "scalding." It is again placed in the vat and pressed for five minutes, then taken out and a

dry cloth put on, again pressed, and allowed to remain without further disturbance for 4 hours, when it is taken from the vat and about 1 lb. of salt rubbed into it by the hand over all the exterior. This salting is repeated during the next three days, when the cheese is taken from the press, washed in warm water, and placed in a room heated to 70° by means of three open pipes passing from an outer room through the kitchen-fire into the cheese-room above. Thus a very economical heat is obtained; the only objection being its sulphurous smell. After twenty days the cheeses are placed in a cooler room, and at three months old are considered fit for sale.

The operations thus described entail a great amount of laborious work, and by the time they are concluded rest must be welcomed. The wife of Mr. Carrington's trusted foreman on this farm, Mrs. Stevenson, has made the cheese for several years, and with the aid of only one person takes the charge of her house and family, and does the entire work of the dairy; and without the help of conveniences and labour-saving appliances, found in many dairies, she makes a fine class of cheese, commanding uniformly high prices; and in the cheese-room can be seen a collection of certificates and awards of prizes given by the Derbyshire, Staffordshire, Liverpool, and Manchester, and other Societies, besides two, value 50*l.*, awarded at the Kilburn Exhibition of the Royal.

The next process to be described, differing somewhat from Mr. Carrington's, is that seen in operation in July for Derbyshire cheese-making at Mr. Milner's, Alfreton. The dairy management on this farm affords a curious illustration of divergence of opinion amongst practical men as to the relative advantages of milk-selling *v.* cheese-making. The farmhouse, situated on a gentle slope some quarter of a mile from the railway station, is very small, and the dairy-room by far the worst of that of any of the competitors. It is most inefficient in its requirements as such, and it has also to serve as the larder and pantry for the family. Yet, with all these disadvantages, and the great facility for cheap delivery of milk to the station (as a hand-cart would most easily do it, thus dispensing with a horse), still Mr. Milner continues to make cheese, and would not take less than 8*d.* per gallon for his milk, even during the summer months, knowing that he can make fully that price of it in cheese.

The milk, about 50 gallons, was renneted July the 8th, at 80° with "Hansen's Rennet," and it is considered most essential to thoroughly mix it with the milk. One hour is allowed for coagulation, when the breaking commences. This is done with a sieve-breaker, constructed of wires placed crossways, so as to cut the curd into about half-inch cubes. The greatest care is

taken in this operation to prevent the whey getting white, which would cause a loss of quality in the cheese. Half an hour is thus occupied; a few minutes are allowed for the curd to settle, when about one-third of the whey is dipped off. A canvas material is then sunk by the hand over the curd, which is gathered into the centre of the tub, and the edges of the cloth placed under it, thus making a very effectual strainer, preventing any curd passing off with the whey, which at this stage escapes through a tap about 9 inches from the bottom of the tub, and afterwards by another fixed at the bottom. A stout perforated board, fitting the interior of the tub, is placed on the curd, and pressure applied by a screw, conveniently fixed over it, for thirty minutes. The curd, which is now of the consistency of cream-cheese, is broken into pieces by the hand, and piled in the centre of the tub. The cloth is again placed over and under it, the perforated board put on, and screwed down. When these operations of breaking the curd, piling it, placing the cloth, and screwing down the perforated board have been repeated three several times, the curd is vatted and pressed for ten minutes, then ground and vatted in sizes varying from 12 lbs. to 30 lbs. The cheeses are then put into the press for ten minutes, then taken out, the edges pared, pressed another ten minutes, again taken out and pared, and a dry cloth put on; after which they remain in the press for five hours. The cloth is once more changed, and the day's work is finished when they are put into the press for the night. During any interval in which the dairymaid is not engaged in the cheese-making of the day, she is occupied in well rubbing salt into the cheeses made the previous three days. On the fourth day they are supposed to have received pressing and salting enough, and are removed from the vats, washed in warm water, bandaged, taken to the cheese-room, and at five months old are considered fit for sale.

Mr. Milner has taken many prizes for his cheese at various local Shows, and they are disposed of almost entirely in the neighbourhood at good prices. Some of them were bored for the Judges, and, although not mild enough for consumers of fine Cheddars, were rich in quality, and would be thought very prime by many with a crust of bread and glass of Burton. The enormous amount of labour entailed on the dairymaid in the manufacture of this kind of cheese will probably check any very great anxiety on the part of many readers of this Report to enter the lists in competition with Mr. Milner for the like honours he has so often taken.

The pigsties are, no doubt, on this farm a source of considerable revenue, being tenanted by a number of capital white pigs, easily and profitably fattened on whey mixed with purchased rice-

meal, besides adding very substantially to the manure-heap. The "black water" (as the liquid manure is here termed), collected from the stables, cow-houses, and sties, is very beneficially applied to the adjacent meadows.

By the kind permission of Mr. Thomas Nuttall, of the Manor House Beeby, Leicestershire, who, in addition to making Stilton cheese on his farm of 350 acres at Beeby, and keeping a shop for the sale of his produce in Newgate Street, London, is making a large quantity at the Etwall Dairy, situated about six miles from Derby, an opportunity was afforded me, on the morning of the 16th of July, of seeing his system of manufacturing this much-appreciated variety of English cheese. After a pleasant drive, I arrived while the milk was being received from the many neighbouring farms, off which Mr. Nuttall gets his supply. By a simple and expeditious contrivance the milk is weighed, and the quantity sent by each person thus ascertained, 10 lbs. being allowed to the gallon. The quality of the different lots is also carefully tested, and a register kept. The milk-cans (or churns) are then emptied into a large strainer, from which the milk passes into the cheese-tub (or vat), 14 feet long by 4 feet wide, made of wood lined with tin, and containing, when full, about 600 gallons. The milk is raised or lowered to a temperature of 79° by means of steam or cold water, admitted into a space in the sides and bottom of the tub between the wood and tin, and the rennet added, made from green cured skins in the proportion of 1 oz. to every 10 gallons. Great care is taken to thoroughly mix the milk and rennet. At the expiration of $1\frac{1}{2}$ or $1\frac{3}{4}$ hour, coagulation is considered perfect, and the next operation commences. Mrs. Nuttall, one of her sons, and two female attendants take their places, two on each side of the tub, and with shallow tin bowls commence removing the mass of curd into cloths, which are placed in tin vessels called drainers, 6 feet long, 2 feet wide and 6 inches deep. Iron rods are fastened across these at intervals of $1\frac{1}{2}$ foot, on which the sides of the cloths are placed. Two of these drainers are fixed on a frame, 2 feet apart, one above the other, standing on wheels for easy removal. As soon as these are filled they are placed on one side of the spacious dairy, and others take their place. Thus, in the space of about twenty-five minutes, all the curd is taken from the tub, which is at once carefully cleansed and scalded. This cleansing is much facilitated by means of an ample supply of steam, always available, and conveyed by pipes to different parts of the dairy from the boiler, which works the steam-engine of five-horse power attached to the premises, and, in addition to thoroughly cleansing the utensils used in such a large dairy, pumps the ample supply of cold pure spring-water from a well

near at hand, to a reservoir placed above the roof of the buildings, heats the cheese and other rooms, grinds the curd, &c. The cloths containing the curd are loosely tied by the four corners, thus allowing the whey to partially separate from it; but it is considered essential that it does not drain off, the old saying on this part of the manufacture being "that it should wallow in its own whey." In about one hour the taps are turned, and it is allowed to drain off, when the cloths, after being tightened, are placed close together in a large drainer of somewhat similar dimensions to the cheese-tub. Here they remain twelve hours, when the whey, which by this time has considerably further separated, is allowed to escape, the cloths are again tightened, and the curd, having now obtained a considerable amount of consistency, is placed in other coolers. The curd is in a little time removed from the cloths and cut into pieces. After remaining in this state twelve or twenty-four hours, it is coarsely ground, and the morning's and evening's curd are well mixed, with $6\frac{1}{2}$ ozs. of finest cheese-salt to every 24 lbs. It is then put into tin hoops with perforated sides, 12 inches deep by 8 inches in diameter; these, when filled, are placed in a room with a brick floor fitted with shelves, and heated to a temperature of 65°. This causes the whey to exude rapidly, gradually ceasing at the expiration of five or six days. The cheeses are then removed from the hoops and taken into the binding-room, where they are smoothed with a knife, and bandaged by strong calico being pinned round them. This smoothing is repeated daily, and dry bandages applied until the cheeses get firm and partially coated, which generally takes place in about twelve days. They are then removed to the drying-rooms, which are also kept at a temperature of 65° by means of steam-pipes, or cooled by water trickling over the slates from a perforated pipe, a capital contrivance placed there by Mr. Nuttall, and working very efficiently. The cheese is considered fit for sale at about six months old, when the 24 lbs. of curd placed in the hoops will have produced a cheese of some 12 lbs. or 13 lbs. In these rooms are many thousands of young cheese, which, under Mrs. Nuttall's skilful management, exhibit every promise of being, when ripe, of equally choice quality to those which formed the four colossal pyramids exhibited by Mr. Nuttall at the Islington Dairy Show of 1877, when he was awarded both the Gold and Silver Medals of the British Dairy Farmers' Association for the excellence of his Stiltons, and for which he has obtained many money prizes, cups, and medals, besides the first premiums at the International Shows held at Frome and New York in 1879, and the First and Second and Champion Prizes at the Dairy Show held in Birmingham this year.

There is a prevalent idea that Stilton cheese can only be made by the addition of extra cream, or that taken from the evening's milk mixed with the new milk of the morning, thus necessitating the making of a large quantity of skim-cheese, unless the milk can be otherwise disposed of. This certainly is not the case at Etwall. It is there made twice a day from new sweet milk, fresh from the cows, by the most simple and natural method possible. Of course, the temperature and atmospheric influences have to be carefully watched, and the operations expedited or retarded accordingly, otherwise it may be almost said to make itself. There is no waste of butter in the breaking or other processes, as is too often the case in many dairies. No pressure is applied, and it is scarcely touched with the hand. A fine rich creamy product is the result, and, although not a cheese for the million, it deservedly commands, with its deep blue veins, the highest price of any made in Britain.

The inspections were most happily fixed. That of the winter took place when it was clear, bright, and frosty; the next in a most beautiful spring-time; and the last in well-nigh tropical heat. The competitors did all they could to render the duties of the Judges pleasant and agreeable. The only drawback was the lamented decease of the largest competitor, the late Mr. W. T. Carrington, of Croxden Abbey, by which sad event each one felt they had lost a friend, and agriculture one of its foremost men.

In conclusion I have to express my cordial thanks to all those who most courteously gave me unstinted information respecting their methods of manufacture, and every opportunity of seeing them in operation.

XXXI.—*Report on the Exhibition of Live-Stock at Derby.*

By Charles Whitehead, F.L.S., F.G.S., &c., of Barming House, Maidstone, Senior Steward.

In the Reports of the Senior Stewards of the Shows held at Carlisle and Kilburn, it was their misfortune to chronicle an abnormal rainfall, and with mournful eloquence to describe its effect upon the soil of the Showyards, and its damaging influence upon the success of the Shows. This present chronicler, on the other hand, is enabled to present a bright record of almost uninterrupted sunshine, as there hardly was a cloud in the sky, and not one drop of rain fell from the opening morning to the end of the Show. While it was a happy and somewhat

novel sensation in the minds of all connected with the Show to feel utterly independent of shooting-boots, macintoshes, and umbrellas, it was at the same time especially satisfactory to consider that the glorious sun was benefiting the agriculture of the country in an extraordinary degree, by duly and thoroughly maturing the corn-crops, by restoring condition and quality to the washed-out grasses of the pastures, and by countless other beneficial processes. In these circumstances it need not be said that we all went to our labours early in the morning with light and cheerful hearts. Our lines, too, were cast in pleasant places, for the Showyard was situated in the very pretty Osmaston Park, close to the town, yet in the midst of rural scenery. This park was adorned, at frequent intervals, with fine trees, which afforded grateful shade to the heated visitors, and under which and interspersed with which the white-roofed sheds appeared in picturesque relief. It was remarked by many that Osmaston Park in many respects resembled Cathay Park, in which the Cardiff Show was held, and that there never has been a prettier ground; nor ever in the annals of the Society has there been one more compact, or better suited in every respect, or, it must be added, more admirably arranged.

All the Stewards agreed in thinking the arrangements of the ground as near perfection as possible. There was no difficulty in finding any particular stand or shed. The cattle, sheep, and pigs were placed well together, and the horse-boxes were ranked in close and intelligible order; so that the Stewards and all the officials were spared many weary steps in the fierce heat of the sun.

The view from the entrance, ranging down the long vista of sheds to the grand stand and the horse-ring, was singularly attractive, by reason of the gay flags and banners which ornamented the implement-sheds, from the bright inspiration of Mr. Jacob Wilson, who always is evolving some scheme from his inner consciousness for the embellishment and improvement of the Showyard. Occasional trees of stately form intervened, and relieved the monotony of parallel lines; and a pretty break was caused by a rustic bridge across the little stream dividing the ground, on either side of which a group of mighty elms spread their foliage. There was a gentle slope from this bridge up to the grand stand, from which standpoint it was interesting and amusing to look down upon the masses of visitors surging to and fro in the main avenue, which literally they filled on the shilling days.

The brilliant weather, with a fairly good show of live-stock, and a most admirable display of implements, properly and judiciously confined by the recent action of the Society within

reasonable limits, and to bonâ fide agricultural requirements, attracted a large concourse of persons, a goodly proportion of whom evidently came to see, and not merely to be seen. More than an average number of the visitors appeared to be agriculturists, or connected with that peaceful art in some way, and clearly meant business; either to buy, or to learn where to buy, the best stock, machines, and implements, and to inform themselves generally to the utmost. From some notice of the movements of the visitors, and from conversations and hearsay evidence, it is concluded that the Show was of more than ordinary advantage to them, and, moreover, of much educational value. After an experience of a dozen Royal Shows in the North, South, East, and West of the country, the impression has been left on my mind by that of Derby that it was one of the most instructive that has ever been held, also that there was an unusual keenness on the part of those who came to it to be instructed, and a realisation of the fact that altered and altering conditions of agriculture require new methods, improved systems, and the adoption of any subject and mode of cultivation that will put money in the purse. In the history of the Society—an eventful record of agricultural progress—there never was a period when its Council and its members, from the highest to the humblest, were more exercising their minds to discover how to bring renewed prosperity to agriculture. Among all the Shows there never has been one at which more grave and earnest discussions have been held, or more anxious thought given to schemes and projects calculated to make land-culture again profitable. Among these the extension of the growth of seeds was suggested, particularly of turnip, grass, clover, mangel-wurzel seed, and peas for market-gardening, not only for home use, but also for foreign use, as it appeared that great quantities of seeds are sent to America and other countries. One grower stated that he had recently had a large order from America for a new kind of pea. Also the cultivation of vegetables was advocated, as well as that of fruit, which might be much extended, as there is a growing demand for fruit in England for various purposes: the possibility of exporting fruit to France and other parts of the Continent also was considered, seeing that English fruit is better than foreign fruit, and comes to maturity at a time when the Continental fruit-season is over. We do a great export trade with all foreign countries in stock and implements. There is no earthly reason why we should not enormously extend the export trade in seeds and selected grain for sowing, and in fruits, which we can grow well if we try. Foreigners, and above all Americans, like the best of everything, and England has a reputation for producing most things well.

Many interesting lessons were learned at the working dairy from the lectures of Dr. Voelcker, and from the practical lessons of Mr. Allender and his staff, illustrated by the best machines, and with the most recently improved and admirably working "Separator," which Mr. Jenkins saw at work in Denmark about three weeks before the Show, and for which Mr. Allender immediately telegraphed upon being communicated with in reference to it. This is a striking instance of perspicacity and energy. It is believed that next year there will be an Exhibition in connection with dairy work upon a much larger scale, to induce more farmers to turn their attention to this branch of agriculture, which may be greatly extended, and to effect much needed improvements in the manufacture of butter and cheese.

The bee-tent attracted many, teaching useful lessons of activity and industry. The diagrams, showing the organs of the bee and the influence of the insect upon the fertilisation of plants, were most instructive; while the cases of ostrich feathers hard by, showed the products of a profitable kind of farming in a tropical clime.

After having bestowed due praise and credit for really good educational work in the right direction, it is a duty to point out the harm which the Council are doing by encouraging the claptrap, sensational grass-growing exhibition in the Showyard, which is wholly misleading to the public. Rye-grasses form at least 95 per cent. of the mixtures sown to produce these rapid growths of brilliant green hue; and every one knows that it is perfectly easy to make rye-grasses yield huge crops in quick succession by sowing plenty of seed, and manuring and watering well. In answer to questions, it was distinctly said that the mixture that produced these results would not be sent to farmers and others for laying land down to grass, nor to those who wished to make lawns. Then, it must be asked, what is the practical use of this cultivation of rye-grasses in an artificial manner? It is calculated to mislead, and can be of no benefit, and should not be encouraged.

The success of the Meeting at Derby was very much enhanced by the admirable preparations made by the Local Committee, and the untiring efforts and hospitality of the Mayor, as well as by the presence of the Prince of Wales, who always takes a deep interest in the proceedings of the Society. It is satisfactory to know that there is a good balance of profit—the result of a large attendance of visitors and of wise retrenchment in the prize-list, and other items. The following statement (in Table I.) shows the gross receipts and expenditure in connection with the Show at Derby, and the number of visitors:—

TABLE I.—STATEMENT of RECEIPTS at DERBY.

Date.		Charge. s.	Charge. d.	Number of Persons Admitted.	Amount Received. £	s.	d.
Tuesday	July 12	2	6	366	45	15	6
Wednesday	„ 13	5	0	3,256	812	0	0
Thursday	„ 14	2	6	12,314	1517	0	4
Friday	„ 15	2	6	18,130	2267	18	7
Saturday	„ 16	1	0	53,291	2670	14	0
Monday	„ 18	1	0	40,639	2018	11	10
				127,996			
Season tickets at 10*s.* 6*d.* ..					327	2	0

	£	s.	d.
Total Received at Entrances	9,659	2	3
Catalogues	632	15	0
Working Dairy	42	4	0
Horse Ring	396	11	0
Gross Receipts at Derby	10,730	12	3

Table II. shows the number of visitors and the gross receipts at each Show for the past ten years:—

TABLE II.—STATEMENT of the NUMBER of VISITORS and AMOUNT of GROSS RECEIPTS at each of the last TEN SHOWS.

Date.	NAME OF PLACE.	Number of Persons Admitted.	Amount of Gross Receipts. £	s.	d.
1881	Derby	127,996	10,730	12	3
1880	Carlisle	92,011	8,594	14	2
1879	Kilburn	187,323	16,213	12	0
1878	Bristol	122,042	11,072	16	11
1877	Liverpool	138,354	14,460	16	11
1876	Birmingham	163,413	13,543	2	8
1875	Taunton	47,768	4,313	19	5
1874	Bedford	71,989	6,165	7	0
1873	Hull	104,722	9,101	18	0
1872	Cardiff	85,185	7,782	18	2

From this last table it will be seen that the attendance of visitors at Derby well bears comparison with that at Kilburn, Liverpool, and Birmingham, and considerably exceeds the number who came to the other six Shows within the last decade. It is worthy of mention that the number of visitors to the Derby Show has only been exceeded at 5 out of the last

26 Meetings, viz., Kilburn, Liverpool, Birmingham, Manchester, and Leeds.

TABLE III.—STATEMENT of the NUMBER of IMPLEMENTS and LIVE-STOCK EXHIBITED at each SHOW from 1872.

Date.	NAME OF TOWN.	Number of Implements Entered.	Number of Live-Stock Entered.
1881	Derby	5,960	1229
1880	Carlisle	4,196	1501
1879	Kilburn	11,878	2879
1878	Bristol	6,837	1354
1877	Liverpool	6,930	1292
1876	Birmingham	6,414	1499
1875	Taunton	4,214	1096
1874	Bedford	5,931	1527
1873	Hull	5,634	1145
1872	Cardiff	5,843	1293

This table proves that the live-stock and implements shown at Derby were not far short of the average number shown during the last ten years, Kilburn being eliminated; though it was supposed by many that they were much below the average. At the Meeting at Derby in 1843, the number of implements entered was 604, and of live-stock, 488.

Having made these few preliminary remarks, it will now be convenient to give a brief description of the different classes of stock, in compliance with the request of the Council that the Senior Steward should undertake this duty. According to the usual practice, and in the order of the Catalogue, the first to be taken are the horses.

HORSES.

Prizes to the amount of 1000*l.* were offered at the late Show for horses of all classes, of which sum 180*l.* was contributed by the Derby Local Committee. At the Show at Derby in 1843, the amount of prizes was only 135*l.*, as shown by Table IV. (page 548).

At the recent Show at Derby, for the sum of 1000*l.* offered in prizes, there were 256 horses entered, against 479 at Carlisle, where, however, many special prizes for hunters and hacks were offered by the Local Committee; 344 at Bristol, 369 at Liverpool, and 428 at Birmingham. Unfortunately, from divers causes, only 192 horses put in an appearance at Derby. It was said that the reduction in the prize-list caused this falling away at the last moment, but this surely would have affected the entries, which are not much below the average of the past

TABLE IV.—GIVING the AMOUNT of PRIZES offered in FIVE CLASSES at the DERBY SHOW in 1843, and the NUMBER of ENTRIES.

CLASS.	Description of Horse.	Amount of Prizes.	Number of Entries.
I.	To the owner of the best Cart Stallion, 4 years old and upwards To the owner of the 2nd best ditto	Thirty Sovereigns Twenty Sovereigns	13
II.	To the owner of the best 2-year-old ditto	Fifteen Sovereigns	3
III.	To the owner of the best Cart Mare and Foal .. .. To the owner of the 2nd best ditto	Twenty Sovereigns Ten Sovereigns ..	8
IV.	To the owner of the best 2-year-old Filly	Ten Sovereigns ..	2
V.	To the owner of the best Thorough-bred Stallion	Thirty Sovereign ..	8
	Total	£135	34

ten years, if the Kilburn Show is excluded from the calculation. Inquiries as to the reason led to the conclusion that many were kept at home by a bad influenza epidemic, or epihippic, more properly, which was very prevalent in all parts of the country, or from the fear of catching the disorder. But the Royal Shows, as a rule, never have had large exhibitions of horses, and one reason is, that a week is a long time for valuable horses to be exposed to risks from the changes and chances of weather in temporary wooden boxes; also that the charges made by railway companies for conveying them is almost prohibitory to those who do not make a constant practice of exhibiting horses for sale or for purposes of advertisement. This applies in degree to all kinds of stock, and greatly militates against the success of the Society's Shows. The Council have endeavoured to persuade railway companies to make special rates and to give special facilities, but they have not been able to induce them to alter a policy which appears shortsighted, to say the very least of it.

The appended Table (V.) shows that 28 counties were represented at Derby in the classes for horses, and that 10 came from Scotland, and 2 from Wales:—

TABLE V.—Setting forth the NUMBER of ENTRIES of HORSES in each COUNTY.

Names of Counties.	Number of Entries.	Names of Counties.	Number of Entries.
Bedfordshire	2	Monmouthshire	1
Buckinghamshire	1	Norfolk	7
Cheshire	13	Northamptonshire	6
Cumberland	4	Northumberland	2
Derbyshire	28	Nottinghamshire	20
Devonshire	2	Shropshire	2
Dorsetshire	2	Stafford	14
Durham	3	Suffolk	34
Essex	4	Surrey	1
Gloucestershire	2	Sussex	7
Herefordshire	2	Warwick	6
Hertfordshire	1	Westmoreland	1
Lancashire	51	Worcester	2
Leicestershire	3	Yorkshire	21
Lincolnshire	1	Scotland	10
Middlesex	1	Wales	2

AGRICULTURAL HORSES.

A wail comes up from many quarters concerning the classification of agricultural horses. There always are wails of some kind or other coming up, many of which are the mere outpourings of spirit from recognised growlers; but this wail has some signification, inasmuch as it hardly seems right that horses of great height, bone, and substance, fitted for very heavy draught-work, should be categorised with farm-horses proper—short-legged, compact, comparatively clean-legged animals. It is not wished by any means altogether to exclude such splendid specimens as "Admiral," but only to have a separate class for stallions of that stamp.

The collection of agricultural horses not qualified to compete as Suffolks or Clydesdales was somewhat disappointing, considering that Derby is the centre of a great carthorse-breeding district, comprising the Midland Counties proper and Cambridgeshire and Lincolnshire. The horses were mostly black in former days, but now are of all colours, and are lighter and more active than they were seventy or eighty years ago, when roads were very bad, and not much land was drained. Only twelve agricultural horses came from Derbyshire, though many farmers in that county are extensive breeders of this class of horses; but it seems that for some years past there has been a great drain upon the horses of Derbyshire, the best mares and fillies having been bought up at long prices. It is the practice also to send

the foals not required to keep up the stock to Ashbourne, Burton, and other local fairs. These are then taken to Leicestershire pastures to be grazed. Waltham fair, near Melton Mowbray, is a great market for these when two and three years old.

In Class 1, there are were only two competitors, probably due to the belief that the victorious "Admiral" would be there in all his glory. First at Carlisle, winner of the 100*l.* prize at the Lincolnshire Show, and the recipient of many other honours, none but rash exhibitors liked to "rush in" to meet him. And this raises the important question as to whether horses which have taken prizes in the classes for old stallions should not be ineligible for entry again in such classes, but should only be allowed to take their chance in a champion class. This would meet the objection of those who urge that it would be impolitic to prevent the exhibition of the perfect types, stamped as such by the Society, and at the same time ensure a better competition among the breeders of each kind of carthorse. The second prize was not awarded in this class. Mr. Gilbey's horse "Spark," a magnificent animal of immense bone and substance, was first in Class 2, beating the two Worsley entries, "Prime Minister" and "Worsley Wonder," both very good horses. "Spark" was purchased by Mr. Gilbey for 800 guineas last February, for the purpose of giving the farmers in Essex the opportunity of breeding horses with the best-known sire. Mr. Gilbey placed him, together with another well-known stallion "Paragon," a descendant of the famous "Honest Tom," in the hands of a committee empowered to make the best arrangements for their service. "Worsley Wonder" took the first prize at Carlisle, as a two-yearling, while "Prime Minister" was placed second. Thus "the whirligig of time brings about his revenges."

For the prizes offered for two-year-old stallions, there was a capital display from thirteen different exhibitors, proving clearly that it is the foregone conclusion of defeat which restricts competition in the classes for older horses. Lord Ellesmere's fine upstanding "Emperor," with famous action, was put first, and his "Silent James," a scion of a good stock, combining the "Honest Tom" blood with that of "What's Wanted," and an attractive-looking horse, but somewhat narrow and a bad mover, was third. It is confessed that it was a slight relief to see Mr. Garrett Taylor's very good, fine-moving "Invincible Wonder," by "Marsters's England's Wonder," snatch some honours from the Worsley stud. The Hon. E. Coke had a useful horse, "Cyclops," in this class, and the Duke of Westminster sent "Sam," a marvel of muscle and size.

Twelve mares came into the ring in Class 13; and a useful

clean-made, short-legged aged mare, "Princess," with a very good foal, was put before Lord Ellesmere's "Beauty," also an excellent specimen. Mr. Coke's "Cinderella," a compact and most useful animal, was a good third. A most difficult task for the Judges was the selection of the best among the eight extremely good three-year-old fillies. After a long and careful examination, they fixed upon "Flower," "Duchess," and "Bessie," with Mr. Hawksworth's capital filly, "Farmer," as the Reserve Number. "Flower" is a fine filly, but "Duchess" is a bad short mover.

There was no animal of sterling merit in the Two-year-old and Yearling Filly Classes. Mr. Coke's first prize, "Chocolate," was a long way the best among the former in a class of ten; and the others in the latter, comprising fourteen, had no chance with Mr. Coke's free-moving "Chance." There were only fourteen entries for the prizes, amounting to 100*l.*, offered by the Local Committee for pairs of Mares and Geldings, and Three- and Two-year-old Geldings. Of these, three were not forthcoming. The second prizes were not awarded in Classes 27 and 28, as there were only two competitors in each class. In the latter Class, Mr. Ratcliff's pair of geldings are as good a pair of horses as were ever put together.

Judges' Report.

In submitting the following Report of Agricultural Horses at the Meeting of the Royal Agricultural Society at Derby in 1881, we may state that we had hoped to see some of the classes more numerously represented, but as a rule the prize animals were good types of the English carthorse.

Class 1. *Agricultural Stallions, four years old and upwards.*—Only three entries in this class, one of which did not appear in the ring, and we awarded the prize to No. 3.

Class 2. *Agricultural Stallions, three years old.*—We had but little difficulty in selecting No. 4 for the first prize in this class. This is a very grand horse of his age; colour black; full of bone and feather, with excellent joints and feet. He looks like doing good service at the stud, and his owner may be proud in possessing such a valuable entire horse. No. 7, second, with good bone and feet.

Class 3. *Agricultural Stallions, two years old.*—Here we had a strong class of eighteen entries, but we had no hesitation in placing No. 22 first, a clean, active, lengthy colt, with capital back and loin, flat-boned legs, and splendid feather; just the stamp of an English carthorse. No. 15, with good bone and hair, second. No. 21, a nice bay colt, with plenty of bone, and a good mover.

Class 13. *Agricultural Mares and Foals.*—A good class. No. 7, a heavy bay mare, was placed first. She has a splendid top, with great limbs, and we considered her far the best mare in the class. Perhaps she had been rather over-fed, from the appearance of her legs. No. 76, a brown mare, twelve years old, second; and we placed No. 74 third. This is a black mare, nine years old, and is a very useful short-legged sort and a fine mover. No. 64 was our reserve in this class.

Class 16. *Agricultural Fillies, three years old.*—A good class; and here we had some difficulty in arriving at our verdict. After some delay it was

settled to put 98 first, 97 second, and 101 third. No. 100 well deserved the reserve number, a bay, with splendid feet and joints, and grand action. This filly is sure to make her mark in the future.

CLASS 19. *Agricultural Filly, two years old.*—To a nice filly, No. 124, we gave the first prize, with plenty of bone and hair. No. 122 was second, and No. 125 third.

CLASS 22. *Agricultural Filly, one year old.*—In this class, No. 154, a black filly, we placed first. She is a fine mover, with great substance, and not shown in very high condition. Second to her is placed No. 144, with No. 143 as our reserve.

CLASS 26. *Agricultural Entire Colts, one year old.*—No. 174 first, a very grand bay colt, splendid joints, feet, and hair; moves well, and with luck he will be hard to beat in the best of company later on in life. He does his breeder great credit, whoever he may be. No. 168, second, is a heavy colt, but very light through his heart, and is not overdone with hind-leg action. No. 176 was the reserve, and he is a useful colt, with good flat bone and plenty of hair.

CLASS 27. *Agricultural pair of Mares.*—This prize was awarded to two mares, seven years old each, a black and a grey. The former is as near perfection as it is possible to see one, having a grand top, with the best of legs and feet, with extraordinary action. She is quite a show in herself. Her companion is also a very useful mare. No. 181 is a capital pair of mares, and they are not easy to beat.

CLASS 28. *Agricultural pair of Geldings.*—No. 183, a grand pair of geldings, one of which came into the ring lame, and we had to apply to our Veterinary Inspector for his advice, who assured us the lameness was only through an accident from his having had his leg over his rope, and that the unsoundness would be of short duration, so that we had no difficulty in awarding them the prize. No. 182, a massive chestnut and a roan, which we did not award a second prize to, according to the Rules of the Society, there only being two exhibits.

CLASS 29. *Agricultural Geldings, three years old.*—We placed No. 187 first, 186 second, and to 189 we gave the reserve. This class we considered not very first-rate as a whole.

CLASS 30. *Agricultural Geldings, two years old.*—This class had only four entries. No. 191 we had but little trouble to place first, No. 192 second, with 190 for the reserve number. We regret that we did not meet with a much stronger class in this county, the home of the English carthorse.

There was no delay in the introduction of the various classes into the ring, and we cannot conclude this Report without expressing our thanks to the Steward of the division for the excellent arrangements he had made and carried out; in fact nothing could have been better.

HENRY SMITH.
V. B. WATTS.
B. SPRAGGON.

CLYDESDALES.

Purely of Scotch origin, natives of Dumbartonshire, Lanarkshire, and Renfrewshire, these most useful horses are found all over England, and are highly appreciated in the United States, Canada, New Zealand, and Australia. It is said that this breed was formed by crossing the native active mares of the Clyde country with Flemish stallions; but good authorities hold that it was established by putting the mares of the district to selected English stallions. Some go as far as to say that hunter stallions were used at first for the purpose, as their fine heads and activity show that their pedigree is not altogether of the cart kind. With

great size they have a long stride, which enables them to get over a lot of plough work. Their heads are comparatively small, with a good crest; their shoulders more slanting than those of other English horses, and they are inclined to be leggy and weak in girth.

Only thirty-five entries of this breed were made, and nine of these failed to appear. Two stallions competed in the class for horses above four years old. "Black Watch," from Devonshire, was put first, and the Judges gave "Pointsman" the second prize, as being a useful animal likely to do good in his generation. It is somewhat strange that there are never large entries of old horses at the Royal Shows. Besides the reason suggested in the case of agricultural horses, probably many of these horses have only just returned from their season's engagements, and are hardly in Show condition in July.

It was thought by some that "Drumpellier" should have been put before "Macgregor" in the Three-year-old Class, and he certainly is a more taking and better-grown horse. "Macgregor" probably is a truer type of a Clydesdale, and he was put first at Carlisle, where "Drumpellier" was unnoticed; and "Macgregor" has never been beaten at any Show. No horse came forward in the Two-year-old Class. Mares and foals were a short show of four, but all so good that the Judges gave away all three prizes. "Queen Mary," a first-class mare and a wonderful mover, was put first, "Flora" next, and "Bell" third. Messrs. Stanfords' "Bella" is a better-made mare than "Bell," and generally of a better stamp, yet lacking bone and size.

Lords Arthur and Lionel Cecil brought that right good mare, "Kelpie," all the way from Peeblesshire, and were justly rewarded with the red ribbon in the Three-year-old Filly Class, though "Annot Lyle," bedecked with the blue, and "Young Maggie" with the orange rosettes, both also from "over the border," were hard to beat. "Kelpie" and "Annot Lyle" had frequently met before in competition, but the latter had always been put first, before the decision at Derby. The noble lords were not so fortunate in the next excellent Filly Class of ten, though they had a good one in "Cornelia;" but she could not "hold a candle" to "Bessie Lee," "Leonora," or Lord Londonderry's nameless one. The following is the Judges' Report:—

Class 4. *Stallions above four years of age* were a small entry, and nothing of first-class merit.

Class 5. *Stallions three years old* were a much better competition; the first-prize animal was really good of his class; the second was also good, and a large well-grown colt.

Class 14. *Mares with Foal at foot* were not numerous, but the first- and second-prize mares were really excellent brood mares, especially the first, which would be hard to beat in any Showyard.

Class 17. *Three-year-old Fillies* were also of good quality, and the first and second fillies were both very good specimens of the Clydesdale breed.

Class 20. *Two-year-old Fillies* were more numerous, and at same time of very good merit.

David Alston.
Adam Smith.

Suffolks.

The valuable suggestion of the Judges of Suffolks as to shoeing should be well weighed by the owners of this and all other breeds. Their lament at the small exhibition of the Suffolks, and of their comparatively second-class quality, was natural and not by any means confined to them, as though they give the idea of being rather "soft," they are a most serviceable breed. They have been entirely altered from the original "Suffolk Punch," whose chief characteristics were "roundness of barrel and compactness of form." Still they preserve the chestnut colour and legs without much hair, though it must be said that the legs are rather long, and shoulders suited for draught and a quick step. Arthur Young, in his 'Six Weeks' Tour,' * writing of Suffolk, says, "They seldom use above two horses in a plough, and always do an acre a day in the stiffest fields;" although in another book he speaks of the "ugliness" of Suffolk horses. It should be mentioned here that several owners of Suffolks did not exhibit, on account of the excessive charges of the Railway Companies; but it is hardly fair to enter animals, and so to put the Society to the expense of fitting up boxes for them, and to withdraw them at the eleventh hour for such a reason. It surely would have been better to have ascertained the charges of the Railway Companies before the horses were entered.

Descendants of "Cupbearer" took the first and second prizes in the Old Stallion Class, the one, "Chieftain," belonging to Mr. S. Wolton, the other, "Crown Prince," to Mr. R. Garrett. "Chieftain" was first in his class at Carlisle, and Mr. Garrett's "Zulu," unnoticed at Derby, was second at Carlisle. Lord Howe's "Kilburn" had a walk-over in Class 8, and Mr. Wolton again led the way in the Two-year-old Stallion Class with "Vivacity," followed by "Chief of the East" and "Light Heart." Six mares and foals of useful stamp, but nothing more, were headed by "Smart," owned by Mr. Green, of Essex. There were no three-year-old fillies. "Jessie," owned by Sir R. Wallace, a pretty though somewhat leggy filly, with good movement, was first in the Two-yearlings, with Mr. Wolton's "Miller's Maid" second, in a class of four. The suggestive remarks of the Judges which follow should be well digested:—

* 'A Six Weeks' Tour through the Southern Counties.' By the author of he 'Farmer's Letters,' 1772, p. 64.

We regret to see the entries so small in so important a breed of agricultural horses.

We regret to see the original character of Suffolk horses somewhat departed from.

Length on short legs is the type one should try to preserve in maintaining the true Suffolk character, whereas many of the entries were too leggy.

A foreign appearance in one or two entries indicated a Flemish strain in past generations.

A little more muscular power in the back and loins, and less erect, would constitute our idea of strength; power without lumber being the essential point in a draught horse.

We noticed that the feet of the horses might be very much improved by allowing the horse to tread more on the frog of the foot, thereby naturally not only expanding the foot, but allowing the natural leverage (the frog) to take the jar off the legs when in work, instead of setting up the shoes at the heels, which prevents the natural assistance which this provides being brought to bear.

Speaking of them as a class, we cannot commend them as representative of what they should be, and what the best of their breed are undoubtedly, viz., able to compete in every point with the best of other breeds of carthorses.

BENJAMIN WADE COOPER.
SAMUEL CRASKE ROPER.

THOROUGHBREDS.

This has never been a strong class at the Shows of the Society, and at Derby it was shorter than usual in number and inferior in quality. At Carlisle seven horses were shown in this class and only five at Derby; whereas eight thoroughbred stallions were shown at Derby in 1843, as evidenced in Table IV.; and it must be said that they were a very indifferent collection, not one of them coming nearly up to the ideal standard of a sire of 14- or 15-stone hunters. But the Judges made the best of a bad lot, and were as patient and critical as if they had a ring full of rare good ones.

Three Brood Mares with Foals competed in Class 23. Nothing can be added to the clear Report of the Judges, except that the prize-money might have been more usefully expended.

In a class of four Heavy-weight Hunters, after careful trials and weary rides in the blazing sun, the Judges gave the first prize to a very good chestnut, "Sir Colin," belonging to Mr. Stordy, and the second to Mr. Starkie's "Slingsby," These prizes, as well as all the prizes for Hunters, were offered by the Local Committee.

The Five-year-old Hunters up to 12 stone were a very good lot, eleven in number. The winner, a clever-looking black aged gelding, "Old Boy," first at Carlisle and a winner at Islington and the Alexandra Palace, is the *beau-ideal* of a hunter. Colonel Barlow was first in the Four-year-old Light-weight Hunter Class with "Floating Feather," a chestnut mare

of thoroughbred form; and Capt. Heygate's "Goldfinch" was second. "Novelty," a black gelding, deservedly much praised by the Judges, owned by Mr. Jordison, was placed first among six Three-year-old Hunters, and Mr. Hawkridge's "Newby" followed. Both these first-rate young hunters, differing in form and size, are by "Duc de Beaufort," the winner of 100*l.* at Kilburn, and this proves that the Judges at that Show made no mistake in putting him first. It has not been thought necessary to say much upon these classes, as there was nothing striking, with the exception of the pair of youngsters, and the Judges have been good enough to furnish much detail:—

In Class 10—*Thoroughbred Stallions for getting Hunters*—the entry was a small one, four only being shown. There was nothing of great merit in the exhibits: the first prize was awarded to a horse with good legs and feet, and fair shoulders and back, but wanting in action; the second-prize horse was too long in the leg for a good hunter sire.

Brood Mares for breeding Hunters were a very poor class, three only being shown. The winner was a fairly useful hunting mare, with a good foal; the second prize went to a light mare, more adapted for breeding race-horses than hunters; whilst the other exhibit partook more of the character of a Cleveland coaching mare than a hunter.

Class 31—for *Hunters up to 15 stone*—contained several very useful horses, the winner being a horse with good action, and like carrying a man to hounds. The second-prize horse was also of the useful, long and low, old-fashioned sort, and looked and rode as if he would be a pleasant conveyance across country; whilst the reserve and highly commended horse was of a useful weight-carrying stamp, and moved well, but lacked the style and quality of his successful rivals.

Class 32—for 12-*stone Hunters*—was the best class brought before us during the day, and brought out some good horses; the winner, though stated to be eleven years old, being as clean in his legs and as free in his action as a four-year-old, and being in our opinion as near the perfection of a 12-stone hunter as we have seen. The second prize was given to a horse with good action and good legs and feet, and though beaten he was anything but disgraced. The reserve number in this class was also a horse of considerable merit, but his legs lacked the stoutness and symmetry of those of his victors.

The class for *Four-year-old Hunters* contained a very inferior lot, the winner being more of the racing than hunting style of animal; the second prize went to a mare with useful top, but not very good legs.

Class 34—for *Three-year-old Hunters*—brought several very promising youngsters, the first-prize colt being the most furnished horse of his age we have ever seen, and also possessing great substance, and looking like making a good weight-carrying horse; the second prize was awarded to a horse of more quality and good action; whilst the reserve number was also a useful horse. We found that both first and second prize horses in this class were got by "The Duc de Beaufort," the horse which took the first prize in the class for Hunter Stallions at the Royal Agricultural Society's Show at Kilburn.

On the whole, we do not consider that the show of Hunters brought before us was, either as to numbers or quality of the animals, by any means a good one.

John B. Booth.
Edwd. Knott.
Robt. Mansell.

Hackney Stallions.

Two stallions were entered in this class, but only one showed up, "Young Perfection," belonging to Mr. Barrow, to whom 20*l.* was given. This horse was first at Carlisle, and second at Kilburn, and has won prizes innumerable in all parts of the country, which probably is the reason why he had it all to himself at Derby. He is a taking showy horse, with good action behind and before, with a kindly eye, and intelligent almost as a human being—"Knows more than many Christians," some bystander suggested—and evidently goes in for winning the applause of the public, which always is freely given; while the fine knee-action of his groom and the gradual casting away of his garments preparatory to action are hailed with much clapping of hands. This groom bitterly complained that a local paper had styled him "a comic groom in charge of a *thoroughbred* stallion," and requested the Senior Steward to write to the 'Times.' "I don't mind a bit being called names myself, sir," said he, "but I can't stand my horse being called names." The antics of the hackney and pony stallions, and their grooms anxious to show them off to the best advantage, are vastly amusing, and form the only sensational element of the Show.

Pony Stallions were by no means good as a class. Mr. C. Wilson's well-known "Little Wonder," to whom the Judges speedily awarded the first honour, was the only really good pony. He is of great quality, very fast, having wonderful action and famous shape. "Nobby," placed second, is fitly described by the Judges as rather common; and Mr. Sanderson's "Mansfield" can only be styled useful, though he was deemed good enough for the third prize.

Hackney Mares with Foals were indifferently represented by Mr. Miller's "Belle," put first, and Mr. Barrow's "Lady Grange," to which the Judges gave the second prize.

Only two Pony Mares with Foals appeared out of three entries. "Cropwell," an ancient dame, with a useful foal, took the first place; and the Judges thought the antique "The French Mare" worthy of the second prize of 10*l.*

In the next class two prizes were offered by the Local Committee for Hackneys above 14 hands 2 inches, and not exceeding 15 hands 1 inch, up to 15 stone. The first prize of 20*l.* was taken by Mr. C. Wilson's good hack "King Charles the 3rd," first at Carlisle; and the second of 10*l.* to his chestnut mare, only four years old, "Pride of the North." There were only three horses in competition.

The Local Committee also gave 20*l.* and 10*l.* as prizes, for Hackneys above 14 hands and not exceeding 14 hands 2 inches,

which were taken by Mr. Robinson with "Lady Heseltine," and the Duke of Hamilton with "Bosco," in a weak class of three.

Four Hackneys above 13 hands and not exceeding 14 hands, competed for the prizes of 10*l.* and 5*l.* of the Local Committee. Of these "Lord Silvertail," first at Carlisle, the property of Mr. Robinson, whose going and utility are spoiled by fatness, was preferred before "Prince," of somewhat common type.

In the last class, for Pony Mares or Geldings not exceeding 13 hands, there was a motley assemblage of six, among which there was not one worth notice but "Fashion,"—really the "glass of fashion and the mould of form"—of which pony the Judges write so truly, and to which they gave the first prize of 10*l.*, offered by the Local Committee. The glory and honour of "Nigger" were of a negative nature, as evidently he received 5*l.* because he was not so bad as those others. The Judges' comments upon these six classes are given below. With reference to their opinion that if the prizes were larger there would have been greater competition, it should be understood that the Local Committee offered the prizes in four of the classes.

CLASS 11.—No competition; a fair horse.

CLASS 12.—58, a beautiful pony, and a very easy win. 59, useful, but rather common. 61, third. 60, reserve, nice pony, but bad hind legs.

CLASS 24.—164, first; 162, second; two fair animals, of nearly equal merit.

CLASS 25.—166, first; 167, second; two fair animals, of nearly equal merit.

CLASS 35.—237, first, a strong, good horse. 235, second, a good horse, but not up to the same weight.

CLASS 36.—240, a grand mare for the class. 243, a good pony, but a little used.

CLASS 37.—249, a very good pony, but too fat. 246, a pleasant good-looking pony, a little worn.

CLASS 38.—252, first, one of the nicest ponies we have had before us to-day.

We regret that the numbers shown have been so small, and we think that if the prizes were larger there would be more competition.

JACOB SMITH.
WILLIAM FLANDERS.
ROBERT ALDWORTH.

CATTLE.

At the meeting of the Council of the Society in May, it was doubtful whether any show of live-stock could be held, in consequence of the prevalence of foot-and-mouth disease in Derbyshire,—the district in which the Show-ground was situated being at that time within an infected area. Owing to the patriotism of the local authorities, who closed the stock-market

at Derby for a time, and to the energetic measures adopted by the town and county authorities, the district was soon declared free, and the Privy Council were enabled to relax their orders restricting the movement of cattle into that part of Derbyshire. But the rumours of disease, without any doubt, prevented owners of cattle from entering animals, and decidedly had the effect of keeping away some of those that had been entered. This explains in a degree why an unusual number of the owners of cattle and sheep which they had entered, did not fulfil their engagements with the Society. A table (VI.) is attached to show the different breeds of cattle for which prizes were offered at Derby in 1843, and the number of entries of each. At the Show just held, there were 391 cattle entered.

TABLE VI.—STATEMENT of the ENTRIES of CATTLE at the SHOW at DERBY in 1843.

CLASS.	DESCRIPTION.	Amount of Prizes for each of the four Breeds.	BREED.			
			Short-horns.	Herefords.	Devons.	Cattle of any other Breed or Cross.
		£	No. of Entries.	No. of Entries.	No. of Entries.	No. of Entries.
I.	Bulls calved previously to Jan. 1, 1841	1st 30, 2nd 15	19	7	4	4
II.	Bulls calved since Jan. 1, 1841	20	17	5	2	1
III.	Cows in-milk	15	18	3	2	8
IV.	Heifers in-calf not over 3 years	15	16	3	1	1
V.	Yearling heifers	10	11	5	3	3
	Total	..	81	23	12	17
	Total amount of prizes ..	420	Total number of entries of cattle 133.			

SHORTHORNS.

There were 132 entries of Shorthorns in the eight classes at Derby, as against 146 entries at Carlisle. Of these, only 100 animals put in an appearance, and the long list of absentees is due to the fear of foot-and-mouth disease, and not to the reduction in the value of the prizes, as has been insisted upon with much iteration. If the entries of Shorthorns had fallen very short of those at Carlisle, this reason might have been fairly

urged; but as the difference is only as between 132 and 146, it can hardly be admitted. It scarcely can be imagined that the diminution of each prize by a few pounds would prevent breeders from sending animals duly prepared and ready. The depressed state of agriculture is no doubt one cause of fewer entries in all the classes for cattle, as well as the gradually growing feeling that the high feeding necessary for prize-winning animals is not conducive to their utility for breeding purposes, and that breeders of recognised strains of the leading breeds, who have never shown a head of cattle, have no difficulty in selling good animals for home use or for exportation. Frequently also would-be exhibitors are prevented from showing in the classes for aged animals, because they believe that their animals would stand no chance against well-established veterans which have gone from show to show, year after year, and swept away the prizes. Of such are "Telemachus 9th," "The Duke of Howl John," "Attractive Lord," "Vice-Admiral," and others of that type, which have rung the changes at the Royal and other Shows with varying success, according to the tastes and predilections of different judges. For such animals, which have gained a position, a Champion Class might be established. This would give agriculturists the opportunity of seeing the finest types of grand old animals together; and at the same time make room for young animals to come to the front, whose owners keep them back now, knowing that they have but little chance against bulls which are fully developed in every point, and are perfectly well known to the Judges. In their report of the Shorthorns at Derby, the Judges confirm this opinion, as they say with reference to Mr. Handley's three-year-old bull, "Master Harbinger:" "Mr. Handley's is high on leg with light thighs, though he may improve in these parts with years." And again they say, with reference to "Great Northern Diver," commended in his class: "This latter will probably develop into a very good animal; at present he, in common with other three-year-olds, is at a bad age to compare with the rest of his class." Let us, for example, take the case of the first-prize bull in the Old Bull Class, "Vice-Admiral," 4 years and 10 months old. This bull has taken a first prize in every class in which he has appeared at the Royal Shows, with the exception of the Carlisle Show, when he stood second to the "Duke of Howl John." Surely "Vice-Admiral" may now be put on the retired list, or be relegated to a Champion Class—an "upper house"—for distinguished "Dukes" and "Attractive Lords." It is a somewhat curious fact that every reporter upon live-stock for this Society has made somewhat disparaging remarks concerning this animal. Thus at Liverpool, Mr. Macdonald says:—"'Vice-Admiral' is a fleshy,

finely shaped, stylish, well-brought-out light roan, not all that could be wished in the horns, and possibly a little rough in his blades ; but altogether a good first. . . . This class is not a very meritorious one." Mr. Caird, in his report on the live-stock at Bristol, writes :—" Mr. Thomas Willis's 'Vice-Admiral,' a roan, with good outline, was first among the Yearling Bulls. He is rather short of hair, and his horns show delicacy of constitution and lack of masculine character. This was a middling class—some useful animals—nothing leading." This bull, put second at Carlisle, is described by Mr. Finlay Dun as "very level and shapely, without lumber, somewhat disfigured by feeble, back-turned horns, and poverty and hardness of hair." The Judges of Shorthorns at Derby remark, that the Aged Bulls were not up to average Royal form, with the exception of Mr. Willis's. "He has greatly improved," they write, "since last season, and were it not for the head and want of hair, he would be a very good animal." This reporter, fortified by good judges who kindly gave him their opinion, could but admire the symmetry of "Vice-Admiral," at the same time thinking that a perpetuation of short hair and back-turned horns is not altogether desirable, and that this bull should henceforth take his chance with his peers. Then there is "Telemachus 9th," over seven years old, upon whom age and forcing have evidently left their marks—indeed, the Judges say : "Years are beginning to tell on the second prize, owned by the Marquis of Exeter ;" yet he is put second, as being distinctly a more fully developed animal than the grandly topped level "Master Harbinger," or the extremely good "Great Northern Diver," or the shapely white "Harold," of Whicholm. No fault is found with the Judges, but rather with the system, which cannot be upheld by any such arguments, if a Champion Class is formed. Of this class it must be said that it was not up to the standard of the Royal Agricultural Society.

After very much careful deliberation, the Judges awarded the chief honours in the Class for Bulls over two years old, to Mr. Outhwaite's "Lord Zetland," a roan bull with a good barrel, but having a plain head and horns. This bull was only honoured with the reserve number in the Yearling Class at Carlisle. Many outsiders liked "Beau Benedict" better than "Lord Zetland," but, though he has a better head and horns, he is not so well shaped. The third-prize animal, "Oxford Duke of Killhow," will make a grand bull some day. There were thirteen animals in this class, which may be characterised as a somewhat commonplace lot.

In the next class of eighteen Yearling Bulls, beyond the prize-winner there was nothing very special. "Orange" easily led,

being a splendid young bull with good flesh and hair, showy, and with a good constitution. Sir William Cayley Worsley's massive animal "Hovingham," with great substance, on short legs, having excellent flesh, well deserved the second place; and Mr. Wakefield's purple roan "Baron Sedgwick," which took third honours, will be heard of another day.

Only thirteen Calves appeared in the ring out of twenty entries, and they must be styled a plain lot, from which the Judges, as it appeared to many, failed to pick the best specimen for first honours in "Andra del Sarto," a somewhat narrow leggy animal, evidently having a delicate constitution, though possessing considerable style and quality. The second prize was awarded to "Derby," a taking-looking calf of very good quality, and the reserve number was given to "Brian Boru," a very useful animal, bred by Mr. Rolls, with a good top and excellent hind-quarters.

A better class of Cows, "in-milk or in-calf," has rarely, if ever, been previously seen in the Royal or any other Showyard. Ten out of fourteen entries put in an appearance, and each was noticed in some way by the Judges. "Lady Carew 3rd" is a very fine cow, without doubt, and was put first, as at the Bath and West of England Show, and at the Essex Show, where she also carried off the 100 Guineas Challenge Cup for the best Shorthorn in the Yard. She is excessively fat, even to disfigurement behind, which the Judges term "patchiness," and has a somewhat stained muzzle, which prevented the Judges at Kilburn from giving her even a commendation; while "Gainful," put first at Kilburn in the same yearling class, was placed third at Derby. "Lady Jane" carried off the second prize, beating "Gainful" and "Gaiety"—an admirable type of a dairy Shorthorn—which have both been Royal prize-winners, though "Lady Jane" only had a reserve number at Carlisle, and no distinction at Kilburn. But she is a good cow, and would probably have been put first, but for a wry horn.

In Class 44, eleven animals were present. The Judges were not long in deciding that Mr. Teesdale Hutchinson's "Gratia," cast in the mould of "Gainful," should have the red rosette. This heifer was shown at Carlisle, but was not distinguished in any way, though "Lady Wild Eyes 15th" was put first; and "Casquette," only highly commended at Derby, took third prize. She has considerably filled out in every way since last year, and has a charming head, good colour, and neat form, but has hardly size enough. It is almost superfluous to say that Lord Fitzhardinge's entry, "Lady Wild Eyes 15th," is a grand heifer of wonderful substance and length, and is certain to develop into a good cow, but she was not quite in the full

bloom of condition. Mr. Stratton must be congratulated upon taking the third prize with a very useful heifer, "Mirthful," which was afterwards sold, as it is understood, to go to South America.

Of twenty entries of Yearling Heifer Calves only fourteen appeared. This is usually one of the most attractive of the Shorthorn classes, but, with two or three exceptions, there was not much merit in the class this year. The decision of the Carlisle Judges in respect of "Lady Georgina Newcomb" and the Rev. R. Bruce Kennard's "Blossom 5th" was upheld, Mr. St. John Ackers's heifer being put first; but Mr. Pugh's heifer, "Czarina Manoravon," not noticed at Carlisle, was put second, and "Blossom 5th" came in only for the third place. At the Tunbridge Wells Show of the Bath and West of England Society, Mr. Kennard's heifer was placed before "Lady Georgina Newcomb." These three are very useful heifers, but, in the humble opinion of lookers-on, were somewhat over fat.

The Judges evidently thought the Heifer Calves a fairly good lot, as they noticed eight out of twelve. Colonel Kingscote was easily first with "Honey 81st," a very stylish beautiful calf, which will in all probability yet bring more distinction to the Kingscote herd. The late Mr. McIntosh's "Havering Gwynne 7th," in the second rank, is a pretty calf, with a wonderful back and loins and an abundance of good hair. "Gertrude 5th" was rightly placed as reserve number, having excellent quality and a good head well set on; but she is a little leggy, and her hocks are not quite well set.

For the two Champion Prizes of 30*l.* each, offered by the Shorthorn Society for the best male and female Shorthorn in the Showyard, Mr. Willis's "Vice-Admiral" and Mr. Teesdale Hutchinson's "Gratia" were selected, after much deliberation.

The Judges of Shorthorns have sent in the appended Report:—

Class 39.—*Aged Bulls* were not up to average Royal form, with the exception of Mr. Willis's, which not only was placed first in his class, but won as well the champion prize for bulls. He has greatly improved since last season, and were it not for his head and want of hair he would be a very good animal. Years are beginning to tell on the second-prize bull, owned by the Marquis of Exeter. The third-prize animal, Mr. Handley's, is high on the leg, with light thighs, though he may improve in these points with years, and the Judges were not unanimous in placing him before the reserve, a nice white, owned by Mr. Nicholson, Northumberland; the head of the latter was considered objectionable. The Marquis of Exeter had a nice bull, "Great Northern Diver," commended in this class. This latter will probably develop into a very good animal; at present he, in common with other three-year-olds, is at a bad age to compare with the rest of the class.

Class 40.—*Two Years old*, with the exception of two or three, were not good. Many would prefer the second-prize animal to the first, and were it not for a little lightness of thigh and an inclination to get down in the back, which the second-prize bull has when not in motion, he would have been placed before Mr. Outhwaite's roan, whose shoulders are upright and head objectionable.

Class 41.—*Yearlings* were not of very high class. The first prize was well brought out, was deficient in crops and shoulders, but stylish; the second prize, a large white owned by Sir William Worsley, is a good sappy bull, and may probably turn the tables on his more successful rival. The third prize was peculiar in colour—purple roan. The commended bulls were fairly good, Mr. Paterson's especially so.

Class 42.—*Calves* were the worst Class of the Show, and do not call for any remarks.

Class 43.—*Cows* were decidedly the best Class of the Exhibition. Mr. Ackers's, first prize, shows more patchiness in her rumps than ever; the Judges hesitated long before placing her above the Duke of Northumberland's, second prize, and were not unanimous in their decision. Mr. Hutchinson's three-and-a-half-year-old might have been further forward but for her hindquarters, which at present are not good. Lord Tankerville's reserve is still a fine cow, but light in front.

Class 44. *Two Years old.*—A good class. Mr. Hutchinson's heifer, wonderfully level in flesh, won here, and subsequently took the champion prize for females. Lord Fitzhardinge's, second prize, was remarkably good. Mr. Stratton's, third prize, was not far behind. Mr. Peel had a good heifer, which was considered over-fed.

Class 45.—*Yearlings* were numerous, several good animals among them. Mr. Ackers was first with a heifer that was spoiled by a narrowness and bareness behind the loin, and a weakness in her thighs; the second was a good animal, faulty in her hindquarters; the third prize was a strong and rather dark-horned animal, of great growth; the commended animals were fairly good.

Class 46. *Calves.*—The winners and reserve were good, and the commended animals little behind.

William Sanday.
George Drury.
L. C. Chrisp.

Herefords.

The entry of Herefords was 33, compared with 40 at Carlisle, 60 at Kilburn, and 40 at Bristol; although the aggregate amount of prize-money offered was 225*l.* as against 105*l.* at the last Show at Derby in 1843, when 23 Herefords were entered, as seen on Table VI., p. 559. The fear of foot-and-mouth disease tended in a measure to prevent the breeders of Herefords from sending valuable animals to Derby, though comparatively at a short distance from their headquarters, and the great demand in foreign countries for good animals of this breed also lessened the number of entries. There is a very large and increasing demand for good specimens of Herefords for exportation to America, for crossing with the native cattle, and especially with those of the Texan breed, upon which they exercise a remarkable influence. It was stated that 500 Herefords had been exported within a very recent period. In their evidence before the Royal Commission on Agriculture, Messrs. Read and Pell say that the Herefords are liked for crossing with Texan cattle because "they travel better than the Shorthorn, and they make such a singular mark upon the cattle. The people know them by their white faces, and the horns of the one and the

other are more capable of being nicely blended than the very long horns and the short horns. They make nicer-looking cattle." It struck many who saw the Herefords at Derby judged and led round the ring each day that there was scarcely an indifferent animal among them, though the Judges are hardly satisfied with them as a whole, and perhaps, taking them all round, they did not quite come up to the usual standard.

In the Old Bull Class, Mr. Turner's excellent even bull, "Pirate," took the first prize, beating Mr. Taylor's aged "Thoughtful," as he did at the Bath and West of England Show at Tunbridge Wells. "Thoughtful" took a first prize at Bristol in the Old Bull Class, a second at Kilburn, a second at Carlisle, and a first prize as a two-yearling at Liverpool, and a first prize as a yearling at Birmingham. It is to be hoped that this veteran will now retire from the "gay and busy scene" of the Royal Showyard, full of honours and dignities. The Judges gave the third prize in this class, though there were only three animals to the fore.

"Trafalgar," belonging to Mr. Taylor, was first in the Two Yearling Bull Class, beating "Horace 4th," which was second at Carlisle as a yearling, while "Trafalgar" only had the reserve number. This decision at Derby agrees with that of the Judges at the Tunbridge Wells Show. There were only two bulls in this class.

It is satisfactory to find a new exhibitor of Herefords in Mr. Rees Keene, who took the first and second honours in the Yearling Bull Class with "Reward" and "Return," most promising animals. The former of these took first honours at Tunbridge Wells.

Mr. Carwardine took both prizes in the Bull Calf Class, in which there were some very superior calves, with "Sir Bartle Frere" and "Romeo," both admirable examples of what calves should be, beating Mr. Turner's "Rudolph" and Mr. Fenn's "Downton Hero," though the Judges at Tunbridge Wells had put the latter before "Romeo.

The Old Cow Class was represented by four animals, all of good form and type. Mr. Taylor's "Modesty" was first, and Mr. Fenn's "Maid of the Teme" second; and the third prize was given to Mr. Myddleton's "Sally 3rd," as the Judges considered her a very good specimen. Mr. Platt's "Lady 3rd" had a walk over in Class 52. She is a superb heifer, with a superior touch, and was placed second at Tunbridge Wells in a class of two. Mr. Carwardine took the first prize for Yearling Heifers with "Pretty Face," a splendid heifer, handling well, with a beautiful head and perfect shape. Mr. Taylor's "Lorna Doone" was second, also an admirable heifer, which, however, was only

commended at Tunbridge Wells, Mr. Turner's "Silvia" being there put second. This was the best Hereford class by a long way, and the Judges gave a prize or commendation to each animal in it. Mr. Carwardine took the first and second prizes in the Heifer Calf Class with his pretty pair, "Venus" and "Henrietta," making five prizes in all, three firsts and two seconds, four out of these prize-winners being got by "Lord Wilton," a well-known sire. The Judges sent in the following concise report.

Having been requested to make a Report on the Herefords, it is our duty to say a few words. They number few entries as compared with some former Shows of the Royal Agricultural Society of England. There are some very good animals, but we think the entries should have been better for a Royal Show. On the whole, with few exceptions, we do not think them up to the usual standard of merit.

John Crane.
Francis Evans.

Devons.

From an entry of 22 Devons, belonging to four owners, 21 came to Derby to compete for prizes to the amount of 215*l.* There were 32 entries at Carlisle, and about the same number at Bristol; but the decrease at Derby is due to the absence of any representatives of Mr. Farthing's well-known herd, which either has taken prizes or received high commendations at every Royal Show since 1850. It is understood that Mr. Farthing has discontinued the exhibition of animals, and has left the field where he has won so much distinction clear for others. No one has done so much as Mr. Farthing to preserve the pure type of Devon and to illustrate it with the most perfect and most symmetrical examples. The show of Devons cannot be considered first-rate, an opinion evidently shared by the Judges, who did not award the third prize in any case; and in Class 60, in which there were only two entries, merely commended the second in merit. This is carrying out the rules of the Society literally and properly, and it would be well if all the Judges would consider that the prizes are not to be awarded as a matter of course, nor as a matter of right to the exhibitors, but only in cases of undoubted and undeniable merit.

Lord Falmouth's first-prize bull "Sir Michael," which took the first honours at Carlisle and at the Bath and West of England Show at Tunbridge Wells, is a splendid beast, level, and exceedingly good in his quarters; Mr. Skinner came second with "Fancy's Robin," a very good animal. "Sweet William," from Mr. Fryer's herd, was placed first in the Two Yearling Class, having taken the second place as a yearling at Carlisle, and Mrs. Langdon's "Jonquil" second. Mrs. Langdon's "Duke of Flitton 15th" was rightly considered the best yearling, though Lord Falmouth's "Banjo" ran him close. Only three Bull

Calves were entered, of which Mrs. Langdon's "Duke of Flitton 17th" was *facile princeps.* Mr. Skinner's "Famous 2nd," bred by Mr. Walter Farthing, carried off the first prize as the best cow, followed closely by Mrs. Langdon's "Temptress 8th." "Fuchsia," a pretty heifer, gained the red ribbon in the Heifer Class for Mr. Fryer, who also carried off the palm in the Classes for Yearlings and Calves with "Canterbury Belle" and "Picotee," both very pretty animals, and likely to make a mark in other showyards.

SUSSEX.

To those who saw the magnificent exhibition of 126 "red Sussex" cattle at Tunbridge Wells in June last, the 24 specimens of this breed at Derby must have seemed a comparatively poor display. Yet the numbers were not below the average, as we find that there were only 20 at Carlisle, and about the same number at Bristol. Derby is a long distance from the homes of this useful breed, and, with very few exceptions, the preparation for the Showyard, entailing the fattening of animals from their earliest youth upwards, is not undertaken by those who breed them for profit. No breed has been so improved as the Sussex during the last 30 years, and no breed is so admirably suited for the pasture-lands of Kent, whether in the famous Romney and Sandwich marshes, or in the rich Pevensey Level in Sussex, or in the poorer meadow-land of the Weald of Kent and of the clays of the Hastings Sand. Their form has been levelled up to fair and comely proportions, and their touch mellowed by happy selection; and it is acknowledged that in respect of early maturity, as evidenced at the Shows of the Smithfield Club, they are fast approaching to the standard of Shorthorns. Kentish and Sussex butchers prefer well-bred Sussex bullocks to any others. Much credit is due to the Messrs. Heasman for their steady persistent work in this direction of improvement of the Sussex breed. They established the Sussex Herdbook, and showed this breed when its value was not appreciated, when Shorthorn, and Hereford, and Devon men passed by them with significant shoulder-shrugs. Separate prizes were given for Sussex cattle first at Leeds. Previously they had been classed with "other established breeds," but at the Canterbury Show in 1860, where Messrs. Heasman first took Royal prizes, it was seen that they were worthy of distinct classification. This was given in several cases from 1861 to 1874, but since the Bedford meeting in 1874 it always has been granted.

In the Old Bull Class, Messrs. Stanford's "Goldsmith," a fine level bull, was first, beating Mr. Hodgson's "Oxford" (304), put first at Tunbridge Wells. "Lord Stanley," belonging to

Mr. Vickers, was put before Mr. Hodgson's "Young Oxford" (445), also set first at Tunbridge Wells. The same reversal of decision is noticed in the Old Cow Class, in which only five animals came out; as Messrs. Stanford's "Dorset 2nd," a famous cow of good touch and hair, very level on her back, with a long deep body, but a little weak between her loin and back ribs, got by that grand old bull "Dorchester," was preferred to Mr. Heasman's "Famous," winner at the Wells, put as reserve number, Mr. Hodgson's "Pitcher 3rd" being second. Mr. Stewart Hodgson carried off the prize in the Heifer in-Milk or in-Calf Class with "Crocus;" and in the Yearling Class with "Laura," in the former of which classes Messrs. Stanford were second with a pretty neat heifer, "Rosedew 3rd," and Messrs. Heasman in the latter with an unnamed yearling.

Norfolk and Suffolk Polled.

This useful breed of animals has figured at the Royal Shows for many years; and it had taken so many prizes and gained so much approbation in the class for "other established breeds," that it was accorded the dignity of special prizes at Battersea in 1862, in the report of which Show one of the Judges writes, that they "presented several specimens of great size and symmetry, with good flesh, and plenty of lean to the fat." Also at the Oxford Show in 1870, where twenty-four entries were made, and at nearly all the succeeding shows it has been similarly treated. There have been wonderful changes in this breed since Mr. Almack described it in this 'Journal' in 1845 in most unfavourable terms,* as those that were shown at Derby, Carlisle, Kilburn, and other Shows were particularly well-shaped beasts, with much kindliness of character and softness of touch, with evidences of good milking properties in the cows. Mr. Sewell Read, in his "Farming of Norfolk," in the nineteenth volume of this 'Journal,' says that "some little attention has been paid to the red polled breed, which are the original Norfolk cattle." Mr. Raynbird, in his report on the farming of Suffolk in the eighth volume of this Journal, speaks of Suffolk cows so noted for their milking qualities as "still being the most general dairy-breed in the county." It is supposed by some that this breed is the same as the polled Galloways of Scotland, but good authorities aver that it is indigenous to Suffolk and Norfolk. A polled breed of cattle will thrive in the quiet of English pastures, but it would not answer for exportation, and would quickly be exterminated in the ranches of Colorado and Texas, where, as Messrs. Read

* Mr. Almack says, "There may be some decent animals among them, but few will venture to say anything in their favour as a breed, except that the cows generally give a great quantity of milk."—*On the Agriculture of Norfolk.* By Baruch Almack. Roy. Agri. Soc. Jour., vol. v.

and Pell say, in their evidence before the Royal Commission on Agriculture, "a muley or polled ox among a lot of cattle is almost invariably so injured that he cannot be canned." Such beasts become "scallawags." "Directly they are stripped, you see the terrible condition they are in, the cattle are much more cruel to each other than those who have to deal with them." At the Kilburn Show thirty-four animals were exhibited, and the Judges expressed the "hope that the Royal Agricultural Society of England may continue to offer prizes (in separate classes) for these useful cattle, wherever their Show is held within reasonable distance of the Eastern counties." Only twenty came to Carlisle, and twenty-one to Derby. Among those there it was difficult to find one entry of indifferent merit. "Davyson 3rd," now the property of Mr. Tyssen Amherst, carried away the first honours, as he did at the Norfolk Show, and at Carlisle and Kilburn, then being owned by Mr. Palmer. Mr. Colman's "Rufus" was in the second place, having been put as the Reserve Number at Kilburn. Both of these are wonderfully active, considering they are nearly eight years old, and display the fineness of bone and good development of hindquarters, with a tendency to slight plainness in the forequarters, characteristic of the breed. Though in fine show condition, and full of bloom in their coats, their flesh appeared to be "lean" meat to a greater extent than in animals of other breeds which had been fattened from calf-hood. "Rinaldo" and "Starston Duke," decorated with the red and blue respectively in the Yearling Bull Class, are promising youngsters. "Rinaldo" took the first prize at the last Woodbridge Show, and is very long and level, and well developed for a yearling, with capital hindquarters. A winner at Kilburn and Carlisle, "Flirt," owned by Mr. Taylor, was most properly first in the Old Cow Class. Mr. Colman's "Silence" was second, a cow of excellent quality, but too small. Many persons declared that "Cherry Leaf," which took the first prize in the Two-yearling Class, a great heifer with good ribs and loins, and famous quarters, would hold her own against any other heifer of the same age in the yard in respect of size, maturity, and general style. This was a capital class, in which every animal was noticed by the Judges. Mr. Colman took first and second prizes for Yearling Heifers with "Dolly" and "Rosamond," both by "Rufus."

The brief Report of the Judges of Devon, Sussex, and Longhorns is appended herewith:—

The Judges are of opinion that the Devon, Sussex, and Norfolk Polled Classes are well represented.

Thomas Cooper.
Henry Overman.
Stephen Bailey.

Longhorns.

Some agricultural writers hold fast the belief that Craven in Yorkshire is the original birthplace of the Longhorns, though it seems somewhat apocryphal. It is more likely that this breed was common to the Midland counties, or to some of them, as Leicestershire, Staffordshire, Derbyshire, and Warwickshire, and that it had extended to Cumberland and Westmoreland. Bakewell is credited with having been the first to discover the virtues of this breed, and to improve it by care and judicious breeding. But it is well known that Sir Thomas Gresley, of Burton, had a Longhorn herd which he delighted to improve, long before Bakewell's time. And Mr. Nevill Fitt states in his interesting essay in this 'Journal,'* that one Webster, of Canley, near Coventry, sold Bakewell his first heifer, which he crossed with a bull from Westmoreland. In the 'Complete Grazier' it is recorded that in 1791 fifteen Longhorns—five bulls and ten cows—were sold for 2464*l.*, or at an average of 164*l.* each, a price which has not been exceeded for Shorthorns in their palmiest days, counting the relative value of money. It is certain that they must have had many good qualities or they would not have taken the fancy of the keen master of Dishley, but they seem to have been supplanted by the Shorthorns, as undoubtedly these make greater weights at earlier ages. "Sixty years ago," as a correspondent of the 'Field' wrote in 1877, "the Longhorn was the most important and fashionable breed of cattle inhabiting the counties of Derby and Stafford, and there still linger yet wondrous tales of the quantity of milk yielded by some favourite cow, or the more marvellous weights which the oxen and heifers attained when grazing in the rich alluvial pastures of the Trent, the Don, or the Derwent." There has been a gradual revival of late. Longhorns have gradually fought their way again into public notice, and after patient waiting have obtained the proud distinction of special classes. They steadily came to the front in the class for any breed or cross not qualified to compete as Shorthorns, Herefords, and Devons, at the Derby Show in 1843, when the first prize of thirty sovereigns went to "James Hextal, of Snibston, near Ashby-de-la-Zouch, Leicestershire, for his 3-years 6-months-old, pure Longhorned Bull, bred by Mr. Dean, of Ibstock." Mr. W. Daniel, of Burton-upon-Trent, received 15*l.* at the same Show, for his 3-years 5-months-old Longhorned Bull, bred by himself.

Out of five prizes in this class at Derby in 1843, four were taken by Longhorns. In 1862, at Battersea, they were first

* 'Longhorn Cattle; their History and Peculiarities.' By J. Nevill Fitt. Roy. Agri. Soc. Jour., vol. xii. s.s.

separately classified, and fourteen entries were made; and at Birmingham again in 1876 handsome prizes were given, for which upwards of sixty put in an appearance. Forty-two Longhorns came to Kilburn, and formed one of the most attractive features of the Show. Exactly the same number were shown at the recent Show at Derby, of which it may be interesting to note that fifteen came from the neighbourhood of Derby, five from Warwickshire, five from Leicestershire, nine from Buckinghamshire, and the rest from Hampshire and Cheshire. The Judges soon gave the Duke of Buckingham's aged bull, "Earl of Temple," the post of honour, and placed "Harlequin," belonging to Sir Harpur Crewe, which took a first prize as a yearling at Carlisle, second. It was remarked that the first is a lengthy bull, of wonderful substance and weight; while the second, a younger animal, was rougher, and not of so good quality. Mr. German's "Prior of Ashby," a handsome yearling with capital quarters, took the first prize in the next class, and "Corporal" was second. Two bull calves competed for the prizes offered by the Derby Local Committee. The first prize went to "Fairy Prince," from the Stowe herd—a useful calf. The second was properly withheld.

On the whole, the females were better than the males. Several of the old cows were admirable representatives of good dairy and meat-making cattle. "Lady Aston," which the Judges put first, is a splendid cow. She was first in her class at Carlisle. Mr. Forrest's second-prize cow, "Walnut," is a good cow, and looks a first-rate milker," as also is "Celia," which was first in the class for heifers over two years old, at Kilburn. The Heifer in-Milk or in-Calf Class was also most interesting. "Rose Leigh," to whom first honours were given, is a beautiful heifer, long and deep and square; though in splendid order, she was by no means overdone with fat, nor showing traces of having been systematically stuffed, and this may be said to apply to the great majority of the animals shown in these classes. The Duke of Buckingham was first and second for yearlings, with a particularly pretty heifer, "Violet," and the plainer, but useful, "Nancy," though some liked Mr. Hall's "Lady Walton" better. Mr. Richard Hall carried off the first prize given by the Local Committee for calves with "Brindled Nell," as nice a calf as could be found in a day's march. The Duke of Buckingham's "Garland" was put second.

Dairy Cows.

It naturally might have been expected that the liberal prizes offered by the Derby Local Committee for Dairy Cattle would have ensured larger entries in all the classes, seeing that

dairying is largely carried on in the district, and that the noted pastures of Leicestershire, Northamptonshire, and Warwickshire are within easy distance, while the rich grass-land of Cheshire is not very far off. Yet, for prizes amounting in the aggregate to 95*l.*, there were only four entries, of which it hardly will be credited two were made by a resident in Surrey, and only one by an inhabitant of Derbyshire. In Class 89, Mr. Vale, of Breadsall, Derby, took the lead with four cross-bred Shorthorn cows, with good bags, and evidently good milkers; and the Judges recommended that the second prize should be given to the other exhibitor, Mr. Ferme, of Streatham Hill, Surrey, for his somewhat ordinary Ayrshires. Two cows had been entered in Class 90, for the best pair of pure-bred Shorthorns, by Mr. Foljambe, but these poor animals, unfortunately, were very badly burned in the railway trucks on their way to Derby. It appeared that the sheeting above them was set on fire by sparks from an engine, and the litter under the cows was ignited. Before the fire was discovered and put out, it had seriously injured both animals, their udders being very much burned, as well as their breasts and bellies. They were taken to the hospital attached to the Showyard on their arrival, and carefully nursed under the direction of the veterinary officers, but were utterly unfit for exhibition. No one but Mr. Ferme, of Surrey, had the pluck to try for the prize offered for a pair of heifers of any breed or cross, in-milk, under three years old. His cows were Ayrshires of average quality. In the next class, for a pair of heifers of any breed or cross under two years old, literally there was no entry, though the conditions were wide enough and broad enough in all conscience, comprehending all races of cattle under the sun. Very much disappointment was felt by all dairy farmers and those interested in the improvement and extension of this branch of agriculture, at the unsatisfactory result of this competition, which its promoters, as well as the Council of the Society and the visitors to the Showyard, confidently expected would have been large, and peculiarly interesting. The Report of the Judges of Longhorns (Classes 68 to 74), and of Dairy Cows is given below:—

Class 68.—Prize animals are good representatives of the breed.
Class 69.—A very useful class; the prize animals very good.
Class 70.—Not a good class.
Class 71.—An excellent class; prize animals showing good dairy properties.
Class 72.—A very good class; Nos. 503, 500, and 502 very superior.
Class 73.—Prize animals useful.
Class 74.—The noticed calves are good useful animals.
Class 89.—First-prize cows very good, showing good milking properties. We recommend second prize to No. 645, they exhibiting great milking qualities.
Class 91.—One heifer good, the other secondary.

Edmund Lythall.
John Treadwell.

Jersey and Guernsey.

Those who may be given to philosophy always have an infinity of matter for reflection and speculation among the animals in a Showyard. One point especially worthy of deep reflection as well as of admiration, is the wonderful manner in which each breed of different kinds of animals has been stamped with distinct features and attributes by the influence of man, to suit his varied requirements and the peculiar necessities of soil, climate, and locality. The dominion of man over the beasts of the field is fully illustrated by the results of his plastic hand upon their forms, of his volition upon their habits and constitution, and upon their very natures. It almost passes belief that the numerous breeds of cattle seen in our Showyards, for example, the stately Shorthorn and the dwarfed Kerry, the brindled Longhorn and the red polled Norfolk, could have sprung, as Darwin and other authorities state, from two archetypal species.* The difference between the "mild-eyed" Jersey and the aboriginal *Bos primigenius*, or *Bos frontosus*, is wide and broad, and one can only exclaim, *Quantum mutatus ab illo Hectore*, and marvel at the effect of natural selection in the first place, in gradually evolving different varieties from a common origin, adapted to surrounding conditions and circumstances. The formation of new varieties, or the alteration and improvement of varieties, by methodical selection, is a comparatively rapid process, and has only been practised, or acknowledged to be a systematic practice, in comparatively recent times. Yet natural selection has been assisted since the appearance of man upon the scene, as Darwin suggests, by an instinctive tendency to preserve the fittest among domesticated animals. The sagacity and energy of such men as Bakewell, Collings, Bates, Booth, Ellman, Druce, and others within the last hundred and fifty years, have formed a methodical system, approaching to the rank of a science, by which the character of the live-stock of this country has been completely changed. In time, no doubt, clear rules and formulas, prescribed with scientific accuracy, and compiled from the practical work of agriculturists, will be forthcoming, and reduce the chances of breeding to a mathematical certainty. It would be vastly interesting, and of immense utility, to have an exact definition of the processes which in seventy years produced such a breed of sheep as the Shropshire Downs, or as the Oxfordshire Downs and Hampshires even in a shorter period, and which have, almost within the memory of individuals, turned some breeds of cattle, as the Shorthorns, into huge symmetrical mounds of meat; and others,

* 'The Variation of Animals and Plants under Domestication.' By Charles Darwin, M.A., F.R.S., vol. i. p. 86.

as the Jerseys, into fleshless, milk-making machines. If men can do all this, within three or four generations, by means of selection, it is difficult to conceive how any limit can be assigned to the operation of natural selection through countless ages. Meditation upon the wonders of a Royal Showyard should make converts to Darwinian doctrines.

Moralising still upon the fitness of things, or rather the fitness of animals, it is striking to notice the great improvement of Jersey cattle within the last ten years. They appear to be better at each succeeding Show, and at Derby some of them were simply perfect in colour, form, and milking qualifications. The Judges have given such an elaborate description, that the Reporter's occupation is gone, so far as the Jerseys are concerned, and there is no necessity for him to allude to individual animals. Reference, however, must be made to the use of the term "escutcheon" by the Judges, as a new point or characteristic in the standard of merit, which was taken into due account by them at the late Show, both in females and males. Though this has been accepted in America and in France for some time, and to some extent in England, it has not been mentioned before by the Judges or Reporters of this Society. The term "escutcheon," or "milk-mirror," as it is called in America, means a natural growth of the hair upon the udder and thighs of breeding cattle, supposed to indicate their milking properties, or their degrees of excellence in this respect. There are several forms of arrangement of this hair-growth, each of which is said to denote a distinct milk-producing capacity. This theory was originally propounded by M. Guenon, a Frenchman, in 1822, who received much honour for it in his own country and in the United States, where it has been adopted by the leading dairy-farmers. An American who was on the Commission appointed to test the system, writes of it thus:—"The escutcheon, then, is that surface on the cow's udder where the hair grows upward. It is not confined to the udder; it extends upwards above the udder, often to the vulva, and outward upon the thighs, on both sides of the udder. These escutcheons are different in shape, size, and quality (quality means the quality of the skin, and of the hair growing on it); and these differences indicate the different milking qualities of the cows, including quality and quantity of milk, and the length of time they will give milk after being with calf. . . . All great milkers have very large escutcheons. In large ones the upturned growth often begins on the belly, in front of the udder, extends along between the teats, and upon the back part of the udder, over the whole width."* There are also tufts of hair (*épis*), whose situation

* 'How to select Cows, or the Guenon System.' By Willis P. Hazard, West Chester, Pennsylvania.

relative to this escutcheon, and other peculiarities, are taken into consideration by the initiated in this system. M. Guenon equally applied this test to bulls, and classified them in the same way as cows, holding that a good escutcheon is even of more importance in a bull than in cows, "when we reflect that he gets from 50 to 100 annually." After the evident reliance of the Judges of Jerseys at Derby upon the escutcheon as an index of valuable properties, there will probably be experiments made with regard to it.

There were 86 entries of Jerseys at Derby, against 56 at Carlisle, and 252 at Kilburn; and 14 entries of Guernseys, against 14 at Carlisle, and 38 at Kilburn. The statement of the Judges that they were not led away by the fascinations of colour and form is most satisfactory, because the production of abundance of milk of high quality should be the main consideration with regard to dairy cattle. Of the entries for Jerseys, eighteen animals were sent from exhibitors in Jersey. Of the sixteen prize animals, seven were imported; four were bred on both sides from adopted parents; two were from animals bred in England for many generations. From information courteously given by Mr. Gilbey, it is gathered that the Island breeders pay more attention to the quality of the animals, and that their system of rearing is solely directed to the richness and quantity of milk; whereas English breeders are apt to overfeed their animals, especially when young.

Report of the Judges of Jerseys and Guernsey Cattle.

We, the Judges, beg to report on the stock submitted to us at Derby. As this Report has been prepared since the awards were made and after the issue of the prize list, we have been enabled to add thereto the names of the exhibitors, breeders, and other information which may serve to make it more interesting, and also render the Report useful for reference.

Jersey Cattle.

The total number of entries in the 6 classes was 88: bulls 27, cows and heifers 61; of these 28 were absent.

Class 75. *Bulls above Two Years old.*—In this class there were 13 entries, but 10 animals only came into the ring, 3 being absent. The first prize, No. 530, "Noble," exhibited and bred by William Alexander, Gorey, Jersey, 2 years and 3 months old, showed innumerable points of quality, particularly in the silky handling of his skin, its rich orange colour, and a well-marked escutcheon. The second prize, No. 521, "Earl of Beaconsfield," exhibited by Thomas Horricks Miller, Singleton Park, Poulton-le-Fylde, Lancashire, and bred by W. H. Wakefield, Sedgwick, Kendal, Westmoreland, 2 years and 7 months old, showed a deal of quality. The third prize, No. 529, "Tolbury Beauty," exhibited by Thomas Oatley Bennett, Tolbury, Bruton, Somerset, and bred by John Le Brocq, St. Clement's, Jersey, 2 years and 2 months old, possessed some excellent points of merit, and he ran the second-prize animal closely for second honours. The reserve number and highly commended, No. 522, "Baron Lionel," exhibited and bred by John

Cardus, Town Hill, West End, Southampton, was 2 years and 1 month old; highly commended, No. 520, "Sir Henry," exhibited by John le Brun, St. Ouen's, Jersey, and bred by Philip Le Feuvre, St. Ouen's, was 2 years and 7 months old. The two last bulls were good animals in a strong class.

CLASS 76. *Bulls above Two Years old.*—In this class there were 14 entries, but 11 animals only came into the ring, 3 being absent. The first prize, No. 545, "Farmer's Joy," exhibited by F. Le Brocq, Augerez, Jersey, and bred by John Arthur, St. Mary's, Jersey ("Farmer's Joy" is by "Farmer's Glory," a most successful bull in getting some of the best stock on the Island, and many of them prize-winners), was 1 year and 4 months old, with exquisite points, fine clean head, lengthy neck, fine horns, yellow thin skin, and the escutcheon well developed. The second prize, No. 537, "Lucifer," exhibited and bred by William Arkwright, Sutton Scarsdale, Chesterfield, Derbyshire, was within a few days of the age of the first prize, very taking to the eye, being a light-coloured silver-grey, possessing many excellent points of merit, clean head and throat, fine horns (a more lengthy animal than the first prize), with a thin skin and good escutcheon. The third prize, No. 534, "Queen's Messenger," exhibited and bred by George Simpson, Wray Park, Reigate, Surrey, was 1 year and 2 months old, with a good head and a few commendable points. The reserve number and highly commended, No. 538, an unnamed animal, exhibited and bred by Mrs. Leigh, Luton Hoo Park, Luton, Bedfordshire, was 1 year and 2 months old, also possessing a few commendable points; highly commended, No. 535, "Longueville Beau," exhibited and bred by James Blyth, Wood House, Stanstead, Essex, was 11 months old (by "Farmer's Glory," the same sire as the first prize-winner); he has a good head, long lean neck set upon thin shoulders, general good frame, covered with a thin silky yellow skin, and also a well-marked escutcheon. Had this animal been a few months older, or in a class for bulls under one year old, he would have certainly taken higher honours. Highly commended, No. 542, "Fuchsia," exhibited by Herbert Addington Rigg, Wykeham Lodge, Walton-on-Thames, Surrey, and bred by J. Norman, Trinity, Jersey, was 1 year and 4 months old (by "Farmer's Glory," the same sire as the first-prize-winner), with many excellent points of merit, and in prize-rings in general would assuredly gain distinction. The whole class was commended.

CLASS 77. *Cows in-Milk or in-Calf above Three Years old.*—In this class there were 18 entries, but 11 animals only came into the ring, 7 being absent. The first prize, No. 559, "Lilian," exhibited by William Arkwright, Sutton Scarsdale, Chesterfield, Derbyshire, and bred by Le Quesel, St. John's, Jersey, was 3 years and 3 months old, with a beautiful head, good horns, fine and turning nicely in, capacious udder, the teats well placed thereon, and a good escutcheon. The second prize, No. 549, "Laura," exhibited by George Simpson, Wray Park, Reigate, Surrey, and bred by G. Trachy, St. Brelade's, Jersey, was 5 years and 6 months old, with general good appearance, well-shaped udder, teats squarely placed, milk-veins prominent, and good escutcheon. The third prize, No. 564, "Souris," exhibited by James Ashcroft, Grange House, Oakhill Park, Old Swan, Liverpool, and bred by A. Le Heron, St. Helier's, Jersey, was 4 years and 2 months old, possessing innumerable good points, particularly so in the rich yellow appearance of her skin, which was silky to the hand, and a well-marked escutcheon. The reserve number and highly commended, No. 554, "Sylvie 3rd," exhibited by James Blyth, Woodhouse, Stanstead, Essex, and bred by Le Brocq, Augerez, St. Peter's, Jersey, was 3 years and 3 months old, possessing many excellent points of merit, particularly so with her escutcheon, which extends well up to the tail. Highly commended, No. 548, "Queen Dora," exhibited and bred by George Simpson, Wray Park, Reigate, Surrey, was 5 years and 1 month old; highly commended, No. 551, "Gardenia," exhibited and bred by John Cardus, was 5 years and 2 months old; highly commended, No. 553, "Longueville

Belle," exhibited by James Blyth, Woodhouse, Stanstead, Essex, and bred by P. Laurens, Longueville, St. Saviour's, Jersey, was 3 years and 3 months old. The last three animals showed many exquisite points which admit of their being classed as animals of great merit. The whole class was generally commended.

CLASS 78. *Heifers above Two and not exceeding Three Years old, in-Milk or in-Calf.*—In this class there were 18 entries, but only 11 animals came into the ring, 7 being absent. The first prize, No. 568, "Patricia," exhibited and bred by George Simpson, Wray Park, Reigate, Surrey, was 2 years and 2 months old, with a beautiful head, well-shaped frame and capacious udder, with teats well placed. The second prize, No. 579, "Daisy," exhibited by F. Le Brocq, Augerez, St. Peter's, Jersey, and bred by John Godel, St. Lawrence, Jersey, was 2 years and 4 months old, with a good head, deep frame, and rich yellow skin, which handled to perfection. The third prize, No. 570, "Elaine," exhibited and bred by John Cardus, Town Hill, West End, Southampton, was 2 years and 3 months old, possessing very many excellent points of merit, which, combined with a well-marked escutcheon, stamped her as fully entitled to run the two preceding heifers very close. Reserve number and highly commended, No. 566, "Lily of the Valley," exhibited by George Simpson, Wray Park, Reigate, Surrey, and bred by P. Le Breton, St. Saviour's, Jersey, was 2 years and 10 months old, of exquisite merit in head, body and udder, with rich yellow skin and a good escutcheon. Highly commended, No. 567, "Lady Gertrude," exhibited by George Simpson, Wray Park, Reigate, Surrey, the breeder unknown, was 2 years and 11 months old; highly commended, No. 571, "Temptation 4th," exhibited and bred by John Le Brun, Caroline House, St. Ouen's, Jersey, was 2 years and 3 months old; highly commended, No. 573, "Stella," exhibited and bred by Findlater Crang, Timsbury, Bath, Somersetshire, was 2 years and 4 months old; highly commended, No. 580, "Lady Mary," exhibited by F. Le Brocq, Augerez, Jersey, and bred by G. Le Quesne, St. John's, Jersey, was 2 years and 4 months old: highly commended, No. 582, "Bella," exhibited by F. Le Brocq, Augerez, Jersey, and bred by J. Gaunt, St. Saviour's, Jersey, was 2 years and 3 months old. The last five heifers were all excellent in quality, and the class as a whole was commended.

CLASS 79. *Heifers above One and not exceeding Two Years old.*—In this class there were 14 entries, but only 9 animals came into the ring, 5 being absent. The first prize, No. 585, "Pandora 3rd," exhibited and bred by George Simpson, Wray Park, Reigate, Surrey (by "Farmer's Glory," previously referred to as a most successful sire), was 1 year and 8 months old, combining in her appearance all the essential good qualities to rank her as perhaps the best female in the different Jersey classes, and with her general good looks she has a good escutcheon. The second prize, No. 587, "Coralie," exhibited and bred by John Cardus, Town Hill, West End, Southampton, was 1 year and 2 months old, possessing a fine clean head, not throaty, fine horn, and general good points of merit. Reserve number and highly commended, No. 595, "Rosabelle," exhibited and bred by Herbert Addington Rigg, Wykeham Lodge, Walton-on-Thames, Surrey, was 1 year and 9 months old, possessing very many excellent points of merit, particularly in the quality and thinness of her skin and well-developed escutcheon. Highly commended, No. 590, "Gloriosa," exhibited by John Cardus, Town Hill, West End, Southampton, and bred by C. B. Dixon, The Vinery, Shirley, Southampton; highly commended, No. 591, "Gravestone," exhibited and bred by William Arkwright, Sutton Scarsdale, Chesterfield, Derbyshire; highly commended, No. 592 (unnamed), exhibited and bred by Mrs. Leigh, Luton Hoo, Bedfordshire. The three last-named animals were worthy of the honours bestowed upon them.

CLASS 80. *Heifers above Six and not exceeding Twelve Months old.*—In this class there were 11 entries, but only 8 animals came into the ring, 3 being absent.

The first prize, No. 602, "Vixen," exhibited and bred by John Cardus, Town Hill, West End, Southampton, was 11 months old, having a beautiful head, fine horns, rich yellow ears, a well-shaped body, the skin also yellow and silky to the touch, and the escutcheon extending on the thighs well up to the tail. The second prize, No. 599, "Gulnare," exhibited and bred by George Simpson, Wray Park, Reigate, Surrey, was 12 months old, showing great promise, head fine, horns thin, a well-shaped body, yellow skin, and excellent escutcheon. Reserve number and highly commended, No. 601, "Goldylocks," exhibited and bred by John Cardus, Town Hill, West End, Southampton, was 11 months old, and in comparison with the prize-winners showed excellent points of quality. The remaining four animals were thought good enough to enable us to highly commend the whole class.

Guernsey Cattle.

The total number of entries in the three classes were 14: bulls 5, cows and heifers 9; of these 5 were absent.

Class 81. *Bulls above One Year old.*—In this class there were 5 entries, but only 3 animals came into the ring, 2 being absent. The first prize, No. 611, "Duke of Devon," exhibited and bred by John Richard Newbury, Hill Barton, Heavitree, Exeter, Devon, was 1 year and 7 months old, with a good head, yellow horn, and excellent quality. The second prize, No. 612, "Squire of Les Vauxbelets," exhibited and bred by James James, Les Vauxbelets, Guernsey, was 3 years and 8 months old, a handsome well-shaped bull, with general good points of excellence. Reserve number and highly commended, No. 613, "Billy," exhibited by W. Wingate Saul, M.D., Fenton Cawthorne House, Lancaster, and bred by J. De Geris, Vrais, St. Peter's, Guernsey, was 3 years and 10 months old, showing all the rich qualities of the breed, but very massive.

Class 82. *Cows in-Calf or in-Milk above Three Years old.*—In this class there were 5 entries, but only 3 animals came into the ring, 2 being absent. The first prize, No. 618, "Lady Emily Foley 2nd," exhibited by James James, Les Vauxbelets, Guernsey, and bred by W. M. Jones, La Marcherie, Guernsey, was 4 years and 1 month old, with a fine blood-like head, deep body, and a most extraordinary large square bag with the teats squarely set on; in all respects this animal possessed the qualities of a good dairy cow. The second prize, No. 617, "Valentine 3rd," was exhibited and bred by the same owner as the first-prize cow. The reserve number and highly commended, No. 616, "Florence 2nd," was also exhibited by James James, and bred by W. M. Jones, the same breeder as the first-prize cow. The last two animals were very good specimens of the breed, but not shown in the same profit as the wonderful first-prize cow.

Class 83. *Heifers not exceeding Three Years old.*—In this class there were 4 entries, but 3 animals came into the ring, one being absent. The first prize, No. 622, "Wild Eyes 2nd," exhibited and bred by James James, Les Vauxbelets, Guernsey, was 1 year and 10 months old, showing all the good qualities of the breed for dairy purposes. The second prize, No. 621, "Dairymaid 2nd, of Les Vauxbelets," exhibited and bred by James James, the same as the first prize, was 1 year and 10 months old. Reserve number and commended, No. 620, "Rosebud 4th, of Les Vauxbelets," also exhibited and bred by James James, the same as above, was 1 year and 11 months old. The last animals had no particular merit beyond being true to the type and character of the breed.

It is necessary to notice that in the above three classes for Guernsey cattle there were only three animals in each class to compete for the 75*l.* offered in prizes, and that 50*l.* of this money was taken by 5 animals exhibited by James James, of Les Vauxbelets, Guernsey.

From the Island of Jersey the number of entries sent were 18, a number which may be considered satisfactory, as at some of the Royal Shows during the past few years the breeders and exhibitors on the Island have been scantily represented, while at Hull in 1873 and at Bristol in 1878 there was not one single animal shown by them.

It is to be hoped that the awards will be satisfactorily received, as we were most careful that quality and richness of produce, with a view to dairy purposes, should guide us in placing the animals for honours. Those animals which were beautiful *only* in form and colour, but without dairy qualities, were passed over. We had, however, few such before us in the ring.

It will be well if breeders of Jersey cattle will bear in mind that their animals should be bred and selected for *dairy* qualities, and that the question of colour of hair (whether whole-colour, fawn, or silver-grey) should after all be secondary to those of richness and quality of milk. In the Herdbook published in the Island to the end of 1874 the total number of cows registered was 1584, and out of these there were only 162 which had no white mark specified—that is to say, only one cow out of every ten was whole-coloured, or only a little more than 10 per cent.

In all breeds it is important to select good sires, but especially is it so in a dairy herd. Accordingly, the bull for use in a herd should be chosen not alone for the colour of his hair or his good looks, but with regard to his parentage. Something should be known beyond the honours he may have won in the prize ring, as the best judges can only select bulls from their general outward appearance and a few essential good points, such as the yellow colour of his skin and its thin silky handling, and an escutcheon of the first order. On the Island the importance of selecting sires from the best milking strains has never been lost sight of, and this accounts for the breed maintaining for so many years its prestige. In the introductory chapter to the English Jersey Herdbook, Mr. John Thornton quotes Thomas Quayle's account, written as far back as 1812; and he mentions the many years during which care had been shown in selecting animals for dairy qualities, and says that at that date the breed had an advantage over any other in the quality and quantity of cream produced from the consumption of a given quantity of fodder; and in another Report in the same book, written in 1839, it is stated: "The Jersey cow was excellent, as she has ever been, which has been attributed to the circumstance of a few farmers having constantly attended to raising stock from cows of the best milking qualities; which attention, prosecuted for a long number of years, in a small country like ours, where such superior qualities would soon be known, has led to the excellence of milking and butter-yielding properties in the race at large."

In concluding this Report, we would suggest that there should in future be an additional Class for Bulls under Twelve and over Six Months old, as the young Jersey bull to turn out with heifers is a most necessary animal in a Jersey herd.

WALTER GILBEY.
C. STEPHENSON.
JAMES ROSS.

SHEEP.

At the Show held at Derby in 1843, sheep were placed in three divisions, and prizes amounting to 315*l.* distributed equally in each. The following Table shows the value of the respective prizes, the number of entries, and the various breeds:—

Description.	Amount of Prizes in each of the Three Classes.	Leicesters.	Southdown and other Shortwoolled Sheep.	Longwoolled Sheep not qualified as Leicesters.
		No. of Entries.	No. of Entries.	No. of Entries.
I. Shearling Ram..	1st Prize £30 .. 2nd Prize £15 ..	35	13	8
II. Rams over 2 years	1st Prize £30 .. 2nd Prize £15 ..	28	15	8
III. Shearling Ewes	1st Prize £10 .. 2nd Prize £ 5.. ..	17	6	2
		80	34	18
Total Amount of Prizes in the Three Classes, £315..		Total number of entries 132.		

Leicesters.

At the late Show at Derby there were only forty entries in the Leicester classes for 90*l.* in prizes, and of these only twenty-seven animals were present; while at Carlisle there were forty-six entries, and at Kilburn sixty-two entries. Mr. Teesdale Hutchinson carried off the three prizes for shearlings, and the first and second for rams of any other age, pretty much as he did at Carlisle and Kilburn. It was a refreshing change to see a new exhibitor, and that one a lady, win double honours with her pens of level ewes. It may be high treason to say that the glory of the Leicesters appears to be waning. They have, however, done good work in their generation, and have imparted their aptitude for fattening to other breeds. For example, there is no doubt that the "Romney Marsh" breed and "Hill Kents" have been very much improved in respect of laying on fat and flesh, and also rendered less leggy, by a judicious intermixture of Leicester blood. Their influence may also be seen in the curly wool of some Kent sheep, in which fineness and lustre and staple have been increased.

The over-fat condition of the cattle, sheep, and pigs, at the Shows of this Society is the subject of unfavourable comment by the public and by the agricultural press, and Mr. Dent's remarks upon this subject, which will be found in another part of this Report, pp. 590–593, are well timed and pertinent, and it does seem that the time has come when a determined stand should be made by the Council to discourage a practice which is seriously lessening the usefulness of the annual exhibition of stock. Many would-be exhibitors exclaim, "What is the use of my sending animals to the Royal, I cannot afford to feed them up to the standard prescribed by conventional fashion, nor can I afford to run the risk of making my best stock unfit for breeding purposes." The cattle are fat enough, in all conscience,

though it was said they were not so fat as usual at Derby; but the sheep were, as a rule, beyond description fat,* "larding the lean earth," and trimmed, and combed, and coloured, and made unnatural, by the "foreign aid of art," not the art which is to conceal art, but that which is intended to conceal blemishes. In all the classes for ewes, except that for the Shropshire breed, the entries were remarkably small, and out of proportion to the rams, due, as it is held, to the unwillingness of breeders to sacrifice a number of their best ewes by making them too fat to breed.

LINCOLNS.

Lincolns mustered thirty-two pens out of thirty-nine entries, or about the same number as at Carlisle, while at Kilburn there were fifty-six entries, and forty-five present. These were quite up to the average standard in point of merit, and seeing that this breed of sheep extends throughout Lincolnshire, and is extensively bred in Rutland, Derbyshire, Cambridgeshire, and other counties, it is somewhat astonishing that there was not a better entry. Mr. R. Smith, in his Report upon the Live Stock at Chester in this 'Journal,'† stated that "60,000 lamb-hoggs" are frequently seen at Lincoln Fair; and Mr. John Algernon Clarke, writing in 1878, said that there often are "from 40,000 to 50,000 hoggs at Lincoln April Fair, where the best pens realise from four to five guineas per head at fourteen months old."‡ So that there must be many flocks of Lincolns not very far from Derby. The Lincolns are grand sheep, with their large frames, yet without coarseness, and their wool of extremely long staple and extraordinary quantity, yet withal fine and lustrous. These refinements are due to the influence of the Leicesters, levelled up by Bakewell, who began to improve them about the middle of the last century. The "Dishley" Leicesters were publicly adopted to improve the Lincolns in 1776, and soon worked a marvellous change. In

---

* It appears from a very old doggrel handed down through several generations that fat and otherwise extraordinary sheep had been seen of old in Derby. This has eight stanzas, of which the first two may be given:—

> "As I was going to Derby,
> Upon a market day,
> I met the finest ram, sir,
> That ever was fed on hay.
>
> "This ram was fat behind, sir,
> This ram was fat before,
> This ram was 10 feet high, sir,
> Indeed it was no more."

† 'On the Exhibition of Live Stock at Chester.' By Robert Smith. Jour. Roy. Agri. Soc., vol. xix. p. 383.

‡ 'Practical Agriculture.' By John Algernon Clarke. Forming part of the 'Memoir on the Agriculture of England and Wales.' Jour. Roy. Agri. Soc., vol. xiv. s.s. p. 586.

the words of Professor Wilson: "The coarseness of the animal frame of the Lincolns gradually disappeared, the flesh was laid on more uniformly, maturity was advanced fully one year, less food was required, and an aptitude to fatten induced . . . the fleece was slightly diminished in weight, but improved in quality."* It is said that whole clips of wool of hoggs in large flocks have averaged as much as 12 lbs. per fleece, and that well-fed rams will shear from 14 to 21 lbs., and, in exceptional cases, as much as 28 or even 30 lbs. of wool. This, of course, only holds upon certain soils, and in certain localities; and it is gathered that Lincolns are not by any means the best sheep for land of poor quality. The prize-winners in all the classes at Derby fully exemplified the characteristic qualities of the breed, together with fine conformation and manifest aptitude to fatten; and it is satisfactory to find, from a statement kindly sent by Mr. Frankish, that the Judges at the recent Lincolnshire Show awarded the prizes to the same sheep, in their respective classes.

There was no difficulty in adjudging Mr. Wright's sheep, Nos. 732 and 734, in spite of a somewhat loose handling on their backs, to be the best rams in the Shearling Class, which was not otherwise of much merit. In the Old Ram Class, a small class of nine, of which Mr. H. Smith, of Cropwell Butler, contributed seven, the three prizes were taken by his sheep—"Manchester," "Lord Lyons," and "Starnhill"—the first-named of which is probably as good a specimen of a Lincoln as could be produced. Mr. Wright took the first prize for Shearling Ewes with a level pen of sheep, and Mr. Roe obtained 10*l.*, given by the Derby Local Committee, with ten breeding ewes of all ages and shapes.

The Judges of the Leicesters and Lincolns also took Class 106, in which the Derby Local Committee offered a prize for the best pen of ten Longwoolled Breeding Ewes, not Cotswold or Lincoln. One pen of Devon Longwoolled, of various ages and qualities, belonging to Mr. Norris, walked over for this.

The following is the Judges' description of the classes of Leicesters, Lincolns, and Longwools.

Leicesters.

Class 93.—Poor class, with the exception of the prize sheep.

Class 94.—Fair class.

Class 95.—Only five pens exhibited; third prize not awarded accordingly. Quality fair.

Lincolns.

Class 99.—Large class, but, with the exception of half-a-dozen animals, an inferior class.

* 'On the various Breeds of Sheep in Great Britain, especially with reference to the character of their Wool.' By J. Wilson, Professor of Agriculture in the University of Edinburgh. Roy. Agri. Soc. Jour., vol. xvi. p. 228.

CLASS 100.—Good class.
CLASS 101.—Good class, but third prize not awarded, according to rule.
CLASS 102.—Good pens.

LONGWOOLS.

CLASS 106.—One competitor; good pens.

JOHN TURNER.
GEORGE WALMSLEY.

COTSWOLDS.

This, probably, is one of the oldest English breeds, and is indigenous to the Cotswold range of hills. It has been improved up to its present standard of size and shape either by selection or by dexterous crossing with other breeds. It had some repute more than 400 years ago; for Stow the Chronicler, in his 'Annals of England,' relates that several of these sheep were exported to Spain in 1467.* In recent years hundreds of these animals have been exported to Australia, New Zealand, and America, as well as to France and Germany, to impart size and wool to native breeds. Cotswolds have the proud distinction of being the largest sheep in the world. Their fleece is of long staple, and very heavy, though not of superfine quality. Their mutton does not rank high; and it would seem, in these days when a sheep of a small breed, say $8\frac{1}{2}$ stones, makes as much as one of 10 stones, or, more plainly, when small joints of "short"-eating mutton make from $1\frac{1}{2}d.$ to $2\frac{1}{2}d.$ per lb. more than the coarser meat of large animals, that very large-framed sheep must gradually disappear. Mr. Lawes, in 1855, recorded a series of experiments, conducted with his usual care, upon various breeds of sheep. He showed that "when liberally fed and protected from inclement weather, the Longwools, especially the Cotswolds, will yield a larger amount of gross increase for a given quantity of food consumed than the smaller Downs or Crossbreds. The average prices of Downs, and also of cross-bred mutton, are, however, higher than those of the Longwools, but not sufficiently so to compensate for the cost of the extra food consumed."† Since these experiments were made, the difference between the price of small mutton (Southdown) and that of large mutton (Cotswold) has considerably increased, and, as Mr. Dent shows farther on, the value of long-staple wool for "lustre" goods has proportionately diminished.

The Cotswolds shown at Derby were not in strong force in respect of numbers, and were only of average merit. Twenty-six were present, eighteen Shearlings, four old rams, and four pens of ewes. At Carlisle twenty-five Cotswolds were shown, and

* 'Annals, or General Chronicle of England.' By John Stow. 1632.

† 'Experiments on the Comparative Fattening Qualities of different Breeds of Sheep.' By J. B. Lawes, F.R.S. Roy. Agri. Soc. Journal, vol. xv. p. 85.

fifty-two at Kilburn. There were only six exhibitors, three of whom shared the prizes. Mr. Russell Swanwick, of the Royal Agricultural College Farm, was first in both the Ram Classes with two good animals, rewards which he has obtained for the first time, and which he richly deserves for his persevering energy. These sheep were not disfigured, but were presented in a fairly natural form. And it must be said that the Cotswolds are shown more fairly and naturally than some other breeds, not so clipped and besmeared with stock-composition. Mr. Brown, who had eight rams in the Shearling Class, took the second prize, but not with the animal he specially fancies. Messrs. Gillett were first and second with two pens of moderate ewes, in a class of only four entries.

Kentish, Romney Marsh, Devon, and other Longwoolled breeds were allotted to the Judges of Cotswolds, who found their work light and made their awards quickly, without any difficulties of decision. Kent and Romney Marsh sheep were not represented: it was hardly expected that Kentish breeders would send their sheep so far, as they only made thirty-four entries for the special prizes offered at the Kilburn Show, close to their native pastures. This very valuable breed has been greatly improved, some hold, by infusions of Leicester and Lincoln blood, by which more compact shape, better fat-making attributes, and improvement of fleece have been imparted, without interfering with the natural hardiness of constitution required to bear the bleak climate of the Marsh of Rumonea (or Roman "ey," or Romney), whose pastures are of famed richness. Some rams of this breed recently have been exported to Australia and America, and its wool has found much favour with Dutch, Belgian, and French wool-staplers. It is a breed well worthy of special encouragement from the Society when the Shows are held within a reasonable distance from Kent.

There were twenty-one entries in the mixed classes, chiefly consisting of Devon Longwools, which well maintained the character they gained at Kilburn for size, good constitution, heavy wool, and early maturity. Originally called "Bamptons," from a Devonshire village, and indigenous to that part of the county, they have been transformed by crossing with Leicesters from leggy, and somewhat coarse sheep, into useful and ornamental animals. Sir John Heathcote-Amory is the great champion of this breed, and was more successful at Derby than at Kilburn. With six entries at Derby he took the first prize with his capital Shearling "Comet," the first in the Old Ram Class with "Kilburn," which was first at Kilburn as a Shearling; and the second prize also with a good ram. He was first in the class for Shearling Ewes. Mr. Thompson, of Kendal, was

second, with a Westmoreland Longwool in the Shearling Ram Class; and Mr. Norris in the Ewe Class with a pen of Devon Longwools. The other breeds shown in these classes were the Wensleydale Longwools, evidently well adapted for the grass-land of the valleys and hillsides of the mountain limestone of that picturesque district.

Annexed is the Report of the Judges of—

COTSWOLDS, KENTISH, ROMNEY MARSH, DEVON, AND OTHER LONGWOOLLED BREEDS.

CLASS 96.—Well represented, and a very good class.

CLASS 97.—Small, but very good.

CLASS 103.—No. 164 we consider a very good sheep.

CLASS 105.—No. 781 we consider an exceedingly good pen of yearling ewes.

WILLIAM H. FLETCHER.
THOS. PORTER.

OXFORDSHIRE DOWNS.

This fine breed is the result of a cross between Cotswold rams and Hampshire Down ewes, in the formation of which an ancestor of the present Mr. Druce, of Eynsham, was especially prominent. Mr. Clare Sewell Read wrote in 1854: "A more intelligible name for this class of sheep would be the Down Cotswold. This cross having been bred for nearly twenty years without the infusion of any fresh blood, has become a distinct breed of sheep." * It appears to be a breed deserving great encouragement, as in it are united the size and quantity of wool and the early formation of meat of the Cotswold with the quality of the Southdown. That it is highly appreciated by home and foreign breeders is shown by the great prices made at recent sales; for at Mr. A. Brassey's sale in July last, fifty-five Shearling rams averaged 13*l.* 10*s.* 8*d.*, the highest figure reached being 24 guineas for an excellent ram bought for an American breeder. Mr. Hobbs sold forty-five rams at 11*l.* 11*s.* each, one of which was bought by Mr. Treadwell for 50 guineas. Mr. M. Druce realised 12*l.* 12*s.* 6*d.* each for fifty-six rams, Mr. Brassey giving 66 guineas for one; and at Mr. Charles Howard's late sale the average of fifty-five rams was 12*l.* 19*s.* 6*d.* It is curious, seeing this, that there were only thirty entries at Derby, as there were sixty-seven entries at Kilburn, and Derby is not a great way from Bedford and Oxford—the headquarters of this breed. Mr. Brassey had some very good specimens of Shearling rams, with one of which (No. 788) he took first honours. Mr. Treadwell's "Baron Newton" was second, and his "Baron Derby" third. His level old sheep "Prince of Wales," by the well-

* 'On the Farming of Oxfordshire.' By Clare Sewell Read. Roy. Agri. Soc. Journal, vol. xv.

known "The Swell," was easily first in the Old Ram Class, as he was first in the same class at Carlisle. Mr. Street, and Mr. Charles Howard, were first and second with pens of very useful ewes.

The Judges have sent this Report of the Oxford Down Shearling sheep:

21 sheep shown are a useful lot, and quite up to the average of previous years.

In the Old Sheep Class there are only three shown, but there are two very good sheep.

In the *Shearling Ewes* four pens are shown; the first and second are very useful sheep.

John Bryan.
William Jonas.

Shropshire Downs.

A fine show of Shropshires was expected, but no one dreamed that 283 animals (from 153 entries) of this breed would be exhibited; or fourteen more than at Kilburn. At Carlisle eighty animals appeared upon the scene. These figures compare most favourably with the numbers of any other breed shown at this or previous Royal Shows. They have only been exceeded by those of the Southdowns at Kilburn. At Carlisle and Derby, Shropshires were considerably more numerous than Southdowns, which are of world-wide reputation. It may not generally be known that Shropshire Downs originated from a breed native of the Longmynd range of hills, described in Plymley's 'General View of the Agriculture of Shropshire,' as a breed "with horns and black faces, nimble and hard, and weigh near 10 lbs. per quarter when fatted. Their fleeces upon an average may weigh 2 lbs. to 2½ lbs." This breed was crossed, it is said, with the Southdowns and Leicesters, and raised to its present perfection of weight of "marbled" meat with Down-like flavour, and quality of wool, combining the quantity of Longwoolled fleeces with the finer staple of the Southdowns. Here then is a breed in which all the desired qualities are united! Here is a sheep which meets the requirements of the time! Surely this is the "coming race"! This breed thrives and maintains an even standard of excellence in all places with proper care and careful selection, as is proved by the success of Mr. Naper in Ireland, and of other exhibitors residing in the Midland counties, and by the experience of many who have seen it flourishing alike in Kent, Surrey, Norfolk, and in other counties whose soil and surroundings totally differ from those of West Shropshire. It is a significant fact, tending to prove the popularity and wide distribution of this breed, that no less than thirty-seven flocks were represented at Derby, while the Cotswolds came from five flocks, the Leicesters from seven, the Lincolns from nine, the

Oxfordshire Downs from seven, and the Southdowns from twelve flocks. A very few years ago it was argued, and with some plausibility, that the Shropshires exhibited at the Royal Shows were not of uniform type, and that the typical Shropshire had not yet been defined. Those who looked at the splendid display of these sheep at Derby, with the most hypercritical eyes, must have failed to detect any diversities in leading points and features, or at least no more than could be found in an equally large assemblage of any other breed. The Royal Agricultural Society may take credit for this perfection of uniformity, having, with the able assistance of their Judges, defined certain "points" which a true Shropshire should possess.

The judging of the Shearling Shropshire Down Rams was the sight of the day. Thirty-eight were selected by the Judges after the most careful examination, and the exhaustive process upon them was long and anxious. Mr. Minton, who first began to show at Birmingham in 1876, obtained the great distinction of the red ribbon with No. 842, a good animal, wanting, as some said, in touch and levelness, but of rare quality. Mr. Naper's sheep, No. 823, was put second, and would probably have gone higher if he had more wool on the top of his head, on the place where the wool ought to grow. Mr. Graham's third-prize and Mr. Minton's fourth-prize animals are good rams, as indeed are the eleven others that were distinguished by the Judges. There were twenty-five Old Rams, from which Mr. T. J. Mansell's "Dudmaston Hero," let at his recent sale for 200 guineas to Mr. Loder, M.P., and in 1880 for 160 guineas, was selected for the first prize, and Mr. Minton's "Royal Reserve" for the second. Mr. Farmer and Mr. Crane took the third and fourth honours, and twelve other rams were commended. Mr. Beach's pen of five ewes was first, Mr. Graham's second, and Mr. German's third ; while Mr. Loder was first with ten very matching ewes of great substance and style, in the next class, and Messrs. Thomas and German took the prizes of 10*l.* and 5*l.* for the best pen of ten breeding ewes, offered by the Derby Local Committee. It will be noted that 80*l.* was subscribed by the Shropshire breeders, and consequently there were four prizes in the first three classes of Shropshires of 20*l.*, 15*l.*, 10*l.* and 5*l.* respectively, and 20*l.* as a first prize in Class 113. The Report of the Judges, given here, will be read with much interest by all Shropshire breeders :—

Report of the Judges of Shropshires.

We have great pleasure in being able to make a satisfactory report after our inspection of the several classes of Shropshires.

The *Yearling Ram* Class, numbering 86 entries, contained fewer inferior animals than in any previous year. The 38 rams selected by us did great credit to the breeders, although we failed to find an animal of extraordinary merit.

The *Aged Rams*, numbering 25, were perhaps the best specimens of true Shropshires ever brought together at any exhibition, which our numerous commendations will testify.

Yearling Ewes.—This grand class, containing 160 ewes, was the admiration of not only ourselves, but also of the public. No 1 pen were very true in character, and of beautiful form. Mr. Graham's noble pen of ewes, which were placed second, were everything that could be desired in form and general outline, but failed to show that true character of the Shropshire so necessary to be placed first in so severe a competition. Third and fourth, and also the reserved number, were true Shropshires of great merit.

Breeding Ewes.—The 60 breeding ewes exhibited were fair specimens, with great scale so desirable in a female, but they did not possess that beautiful type of character shown in the previous class.

JOHN COXON.
JOHN EVANS.

SOUTHDOWNS

Were a capital and interesting collection, to which the noted exhibitors contributed. This is the fashionable breed *par excellence*, and that which men of high degree delight to keep. It is true that more mutton and wool are obtained from larger kinds of sheep; but quality compensates in a degree for quantity, and it is found that many shrewd practical men stick closely to their Southdown flocks. Southdown mutton is always in demand at better prices than can be obtained for any other kind, and especially in the neighbourhood of watering-places, where small joints are preferred, and visitors do not mind what price they pay. Only a few years ago the faces of Southdowns were much darker than those of the animals shown at Derby and recent Shows. They are reverting more in their features to their original colour, which was grey, or speckled grey. Sussex Southdowns, perhaps, were lighter faced always than those in other districts; but it appears that the faces of all the flocks are being gradually made of an uniform grey tinge. Very pleasant it was to find our "familiar friend" Mr. Rigden at the head of the list in a good well-filled class of Shearlings, with Nos. 982 and 984, beating the Merton and the Goodwood entries, and those of Mr. Colman, less known to fame. Also to note his symmetrical three-year-old, No. 1017, first at Tunbridge Wells in a good class, which was placed between the Duke of Richmond's and Lord Walsingham's sheep. Mr. Rigden did not show any ewes, and the prizes went to a good pen from Mr. Colman, and a pen of ewes, with backs as level and as smooth as a lawn, hailing from Merton. The remark of the Judges that this breed was well represented at Derby was generally endorsed by the visitors.

Hampshire and other Shortwoolled Breeds.

Many persons wonder that the Council of the Royal do not give special prizes for Hampshire Downs. Many hold that these are the veritable "coming" sheep, and set them above the Shropshire Downs. But they have not the quality nor the style, nor the taking form of the latter breed; neither is their flesh so delicate, nor their wool so good. This at least is the opinion of an unprejudiced witness who has fed both. Nevertheless it is a fine breed, adopted and appreciated in various counties and countries. The early maturity of these sheep is marvellous. Wether-lambs, seven or eight months old, will weigh from 25 lbs. to 30 lbs. per quarter, and are sold in hundreds at Britford, Overton, Wilton, and Weyhill fairs, at prices ranging from 48*s.* to 57*s.*, and even to 60*s.* each. It is customary, as many are aware, to work ram-lambs of this breed; and just after the Derby Show, 100 ram-lambs, not eight months old, made an average price of 11*l.* 16*s.* 3*d.*, at the Fonthill sale, for immediate working. Ram-lambs of this breed have been let for 60 guineas for a month's service, and last year one firm of auctioneers in Wilts sold 1100 ram-lambs, at an average price of 10 guineas each,—not a bad price, considering the scarcity of money and the bad times!

Only eighteen Hampshire Downs came to Derby. "Any other Shortwoolled Breeds" were represented by a solitary Lonk, which looked unusually sheepish, and was decidedly "remote, unfriended, melancholy, slow." It is hardly necessary to say that he was not noticed by the Judges, who gave the first, second, and third prizes for Shearlings to Mr. Alfred Morrison, for his very superior trio of true type and character, of great weight, good flesh, and heavy wool. All the sheep in this class were good. Mr. Morrison took the first and third honours with two good Old Sheep, in a class of six:—"a noble payre," as a Wiltshire shepherd called them—Mr. Lambert taking the second prize. The four pens of ewes were a very even and excellent lot, the prize-pens of Mr. Read, Mr. Lambert, and Mr. Parsons, put respectively first, second, and third, being as good perhaps as were ever seen, showing in an eminent degree the great improvement made in this breed. Mr. Parsons' pen was so good that the Judges recommended that the third prize should be awarded.

The Report of the Judges of Southdowns and Hampshires, annexed, gives fuller details than the Reports of some other Judges:—

The *Southdowns* were well represented, most of the principal breeders sending sheep in the different classes.

Class 114. *Yearling Rams.*—39 entries; 4 absentees. This class was well

represented, and amongst the exhibits there were some exceedingly good animals. Some of the breeders in endeavouring to increase the size have lost somewhat in symmetry and quality.

CLASS 115. *Rams of any other age.*—20 entries; 3 absentees. There was a very superior lot of sheep exhibited in this class, so much so that the Judges commended the whole class.

CLASS 116. *Pen of Five Shearling Ewes.*—11 entries. It was not quite so large in point of numbers as on some former occasions. The quality of the ewes in this class has seldom been exceeded. They were a very grand show.

The classes allotted for Hampshires and "other Shortwoolled Breeds" were filled with sheep of the former breed, with the exception of one Lonk in the Aged Ram Class, which appeared quite out of place amongst the superior exhibits of Hampshire or West Country Downs. Year by year this rent-paying breed of sheep appears to increase in quality without any diminution in size.

CLASS 117. *Shearling Rams.*—11 entries (several absent). This class was well represented. The three prizes were awarded to one exhibitor, Mr. A. Morrison, of Fonthill, whose flock of late years has taken the lead.

CLASS 119. *Rams of any other age.*—9 entries. The sheep in this class were not so numerous or so good in quality as the younger sheep. Mr. Morrison was here also to the fore with a good specimen.

CLASS 119. *Pen of Five Shearling Ewes.*—5 entries; 1 absent. Though this class was not largely filled, the quality of the ewes was very superior. There were not sufficient entries to make the third prize offered available, but the excellent quality of the whole class induced the Judges to specially recommend its being given to No. 1062.

JOHN FORD.
EDW. LITTLE.

It will be seen by the annexed Report of the Inspectors of Shearing, that upon the whole there is less to complain of than in former years.

Report of Inspectors of Shearing.

We, Inspectors of Shearing, have felt it to be our duty to recommend the disqualification of three numbers, viz. Nos. 810, 877, and 1046, and in doing so we beg to state that we are quite warranted in recommending these disqualifications on account of the old wool and extra trimming that those sheep have about them. We had certainly some little doubt as to a few others, which were not so clearly shown, and to which we gave the benefit of any doubt in our minds. On the whole, we had not so much to complain of as in some former years.

WILLIAM JOBSON.
J. B. WORKMAN.
JAS. E. RAWLENCE.

Mr. Dent, the Steward of the Sheep Department of the Show, has been good enough to assist the Senior Steward by writing the accompanying elaborate Report, which is both interesting and suggestive:—

The sheep shown at Derby in 1881 presented a great contrast in numbers and variety of breed to those exhibited at the same place in 1843. In that year Leicesters were the only breed placed by themselves. Southdowns were grouped with other shortwoolled breeds, and there were in

addition six prizes divided amongst "other Longwools not qualified to compete as Leicesters." In the latter division the prizes were all taken by sheep of the "improved" or "new" Oxfordshire Longwoolled breed. This year the Longwools were separated into the three breeds of Lincoln, Leicester, and Cotswold, with a group embracing "Kentish, Romney Marsh, Devon, and other Longwoolled Breeds," an incongruous mixture of very moderate sheep, which might, I think, very fairly be removed from the prize list. The middle breeds, if I may so call them, were divided into Oxfordshire Downs and Shropshire Downs, and the Shortwoolled into Southdowns and "Hampshire or any other Shortwoolled Breeds." In 1843 the prizes amounted to 310*l.*, in 1881 to 800*l.*

During the period which has elapsed since 1843 the breeds, which I should venture to class as middle breeds of sheep, have come more prominently to the front, the Shropshire, the Oxford Down, and Hampshire giving greater weight of mutton and a heavier fleece than the Southdown; and being more popular with butchers and consumers, from having a higher quality of mutton and not so much waste in fat as the Leicester or Lincoln. During a portion, however, of the time which has elapsed, the long lustre wool of the best Lincoln and Leicester breeds was high in price, and the success of the Bradford fabrics kept up the value of these classes. Changes of fashion tell upon manufacturers and farmers alike, and the æsthetic tastes for soft fabrics and delicate colours have caused a serious depreciation in Bradford stuffs and in lustre wool. This was, I think, reflected in the Show at Derby, for the Longwoolled sheep were decidedly not so numerous nor of so high a quality as have been seen before. We do not find many aristocratic names amongst the exhibitors of Leicesters, Lincolns, or Cotswolds. Their owners are for the most part tenant farmers, and the serious depression of the last three years may have had something to do with the diminution in the numbers exhibited. The Leicesters range from North and East Yorkshire to Cornwall, but their home is principally on the Yorkshire wolds; and in some flocks a dash of Lincoln has been introduced for the sake of increasing the fleece and carcass; while in many folds and markets, both in Lincolnshire and Yorkshire, cross-bred sheep are to be seen, the produce of Shropshire or Hampshire rams and the whitefaced ewes. Generally the accounts of loss from fluke disease during the last two years were deplorable, and I heard of several cases of serious fatality which had occurred amongst lambs last year between the weaning time and the period at which they were placed on turnips. One Yorkshire shepherd informed me that his master had lost about 250 lambs last autumn. From the heath districts of Lincolnshire, where the Lincolns thrive best, I was glad to find a more hopeful tone amongst the shepherds, both with respect to the health of their sheep and the prospects of the turnip and barley crops.

As might be expected in the Midland district, the Shropshire breed of sheep was the distinguishing feature of this department. A committee of breeders augmented the prizes offered by the Society, and a noble show of this thoroughly useful sheep responded to the offer. Sixty-one Shearling Rams were inspected by the Judges, and from these thirty-eight were brought out for further revision. The Judges said that as a whole they had rarely seen a finer lot of sheep than these thirty-eight; but, when by repeated drafting the number was reduced to the five selected for the prizes and reserve number, some considerable time was spent in placing the sheep, from the fact that no one or two of them were of such individual high merit as to stand out prominently from the rest. Each of the selected sheep had some weak point. The Irish sheep which stood second, and another from the same flock which was highly commended, made a brave show for that country, considering the long and wearisome journey which they had experienced;

and it is a very satisfactory thing to see an Irish landlord, undismayed by the agitation against his class, doing for the sheep of his country what Irish landlords and farmers have so successfully done for cattle, importing the very best English blood, and improving materially the stock of his neighbourhood. Judging by the growth of these sheep, we may suppose that the Irish soil and climate are very favourable to them; and Shropshire breeders claim that in the Lothians of Scotland, and in our colonies all over the world, their breed can hold its own.

The nineteen Rams of any other age were a magnificent lot. There is no doubt that the three-shear sheep are more highly developed, and fill the spectator's eye more grandly than the two-shear, and the lion's share of prizes fell to the older sheep. And this raises the question discussed at the General Meeting in the Showyard, as to the restriction of the ages of animals exhibited. Is the Royal Show to be an exhibition of the fullest developed and most matured specimen of each race, irrespective of the use of the animal for breeding purposes; or is it to be an exhibition of animals best qualified to reproduce their species? Are we to encourage over-fed aged animals, taken about from show to show, and from year to year, as a trading speculation; or breeding stock which any farmer would select for use in his flock or herd? I am very much afraid that the former is our present position, and will be so long as the public eye is guided by fat rather than by form; and many breeders are deterred from sending their animals by this senseless system of overfeeding which is prevalent in all classes. To return, however, to the Shropshire sheep. Nothing in the Showyard was more beautiful and striking than Class 112, containing 26 pens of five shearling ewes. It was no easy work for Judges or Steward while these sheep were inspected on that close Wednesday afternoon, and the interest in the decisions was maintained to the last. For my own part, I should not have known where to stay my hand in commendations, and I thought that some unnoticed pens might well have had a card; but I am not a judge, and could only thank Messrs. Evans and Coxon for the very patient and successful labour they bestowed upon their work. Sixty breeding ewes in six pens made a grand finish of the breed. Each had brought up a lamb, and the whole class received notice for their good quality and size.

Southdowns, the aristocracy of sheep, were well represented; and in the midst of Princes, Dukes, and Earls, a tenant farmer carried off the first prize. No one can be surprised at men of large acreage, with wide parks and grazing grounds, delighting in the Southdown. There is such an air of breeding and birth about him, he looks like the Jerseys amongst cattle, a fit denizen of an English park. But while the breeders of these sheep admit his value in this respect, they also claim that on the poor down-land from which he originally came there is no sheep more useful or more capable of gaining his own living. Thirty-three shearling and sixteen older rams, with nine pens of shearling ewes made up a good display of the breed.

Oxford Down and Hampshire Down sheep were not in great numbers, but those shown were good representatives of these useful farmers' sheep, producing heavy fleeces and plenty of good mutton.

From inquiries amongst the shepherds, I would hope that the ravages of the fluke disease are now much abated. It is grievous to hear how sheep-breeders have suffered from this fell complaint, and also from fever and scour amongst lambs resulting from the wet seasons. I add the Report which I received from the Judges of Shearing. I did not envy them their work on the warm afternoon which they dedicated to it. If anything, they erred in leniency. The doctoring with washes, and the trimming and clipping into shape, are more extravagant than ever. It is absurd to see the shape-boards and the shears at work on the day before the Show. No fair dame whose charms

are waning has more elaborate preparation bestowed upon her by her maid than have these show sheep by their careful shepherds; and I wish the ability and ingenuity which these good fellows display in colouring and trimming were exerted in a better cause. The shepherds are always a pleasant cheery class, and it was a great pleasure to me to meet old faces with whom I made acquaintance in 1863, and to see amongst the new ones one beginning at as early an age as eight to look after a prize sheep. I am a warm advocate for a good education for all children, our own as well as the shepherds', and that they should learn what is useful; but a boy will be far more likely to become a valuable servant if he gets out with his father to the byre or the fold as soon as he has got a good mastery of the elements of general education, than he would be if he were kept at school till thirteen or fourteen, studying some of the wonderful descriptions which compilers of school-books give of our domestic animals. We must impress on our labourers the necessity of sending their children early and regularly to school, and so being able to teach them the things of common life at eleven or twelve years of age, and allow them to get that knowledge and love of animals which can only be acquired by being constantly amongst them.

My impression from our Show is certainly that the dark-faced sheep are gaining ground, and that the Leicester and Lincoln are not making the same progress. One word of cordial thanks to all the servants in the department, and to my brother Stewards for their kindness and courtesy throughout the Show.

JOHN DENT DENT.

PIGS.

The Steward of Pigs is the subject of a good deal of chaff during his stewardship from his brethren, whose lots are cast in more agreeable places, and it is not at all surprising that when the Steward of this interesting department was asked to furnish information, and to give details concerning it, he replied that he had not studied the subject sufficiently, on account of the heat and the odours.

Besides the odours, not exactly of "Araby the blest," it is painful to see the prostrate masses of fat "grunting and sweating under a weary life" in the heat, and to reflect upon the tortures of many which have had to travel and would have to travel, it may be, hundreds of miles, pent within the narrow confines of a crate. These are indeed helpless victims of overstrained selection, of an *un*natural selection, that has turned them into mere fat-making machines, with about as much consciousness of existence as jelly-fishes. Seriously speaking, this has come to such a pass, that it is time that a check should be put to the unlimited exhibition of animals which plainly cannot be in a fit state for breeding purposes.

In point of numbers and quality, the show of pigs was quite up to the average, as the accompanying Table (VII., p. 594) illustrates. Though the amount of prize-money given at Derby was 37*l.* less than the average of the last four years, the number of pigs entered there was only one short of the average number

of the entries during the same period, which tends to corroborate the assertion that other causes than the reduction of the prize-list served to keep the owners of horses and cattle from making entries.

TABLE VII.—STATEMENT of the NUMBER of PIGS of various BREEDS entered at the SHOWS at DERBY, CARLISLE, KILBURN, and BRISTOL, and the GROSS AMOUNT of PRIZE MONEY offered at each SHOW.

	Amount of Prizes.		Large White Breed.	Small White.	Small Black.	Berkshire.	Any other Breed.	Total.
	£	s.						
Derby ..	240	0	47	38	22	59	No prizes offered	166
Carlisle ..	300	0	23	28	19	26	37	133
Kilburn ..	285	0	33	45	21	67	37	203
Bristol ..	285	0	24	28	28	61	24	165
Average of 4 years	277	10	32	34	22	53	..	167

A comparison of the number of entries of pigs, and the prizes given for them at the first, with those at the recent Show at Derby, will be productive of interest.

TABLE VIII.—Giving the NUMBER of PIGS of various BREEDS entered at the DERBY SHOW of 1843, and the AMOUNT of PRIZES.

CLASS.	DESCRIPTION.	Amount of Prizes.	Entries.
I.	Boars of a Large Breed .. .. .. First Prize £10, Second Prize £5 ..	Fifteen Sovereigns	8
II.	Boars of a Small Breed .. .. .. First Prize £10, Second Prize £5 ..	Fifteen Sovereigns	10
III.	Breeding Sow of Large Breed ..	Ten Sovereigns ..	10
IV.	Breeding Sow of Small Breed ..	Ten Sovereigns ..	21
V.	Three Breeding Sow Pigs of same litter, over 4 and under 9 months	Ten Sovereigns ..	11
	Total	£60	60

THE LARGE WHITE BREED.

As with Clydesdales, so with pigs of the Large White Breed, the Earl of Ellesmere was first and foremost, and took three first prizes in the three first classes of this breed, and the second prize

in the fourth class. In the first class the young boar was a nameless and an excessively well-to-do animal, as was Mr. Tom Strickland's second-prize pig. Lord Ellesmere's first-prize boar, in the next class, "Samson 4th," which some one styled a "shapely monster," was pushed hard by Mr. Sanders Spencer's "Sampson 6th." There were no less than three different "Samsons," or "Sampsons," in this class. "Daniel Lambert," and the "Fat Boy in Pickwick," surely would be more appropriate names for these prodigies of tallow! Mr. Hall, of Belper, was first in the Breeding Sow Class. There were fifteen different exhibitors of the Large White Breed.

The Small White Breed

Is a most useful breed, and was fairly well represented by animals from nine different breeders. Lords Ellesmere and Moreton obtained the chief honours. For Young Boars, Lord Moreton was first, and Mr. Spencer took the second place with "Esau 3rd." In the Old Boar Class, Lord Ellesmere's "Robin Hood" was put first, and Mr. Ashcroft followed. Lord Ellesmere took the lead in the class for Breeding Sow Pigs with three "little beauties," as an enthusiastic pig-fancier called them; and a pen from Tortworth, to which the second prize was awarded, might have been similarly styled. Mr. Duckering was first, and Mr. Sanders Spencer second in the class for Breeding Sows.

The Small Black Breed.

There were twenty-two entries of the Small Black Breed, of which eighteen were present, belonging to seven breeders. Some hold that the Society should not offer prizes for this breed, as it is gradually decreasing in numbers. Their special qualifications appear to be early maturity and rapid laying on of fat above all other breeds; and it is decidedly in their favour that they are small, as it is a certain relief to look upon small fat objects after very huge fat objects. Mr. Gilbert's "Sir Charles," first among the Young Boars, is a good pig, as is Mr. Duckering's, which was put second. Mr. Wheeler and Mr. Duckering took the prizes for Old Boars. The Duke of Hamilton and Mr. Duckering for the Young Breeding Sows, and Mr. Duckering and Mr. Wheeler for Sows.

Berkshire Breed.

This popular breed was in good force at Derby, both as regards numbers and excellence. Seventeen breeders made entries. The first prizes in the Boar Classes went to Mr.

Russell Swanwick, and the second to the executors of Arthur Stewart and to Mr. Duckering, who exhibited animals in thirteen out of the sixteen classes of pigs of the four breeds for which prizes were offered. A pair of very good breeding sow pigs, owned by Mr. Hewer, were first, and Mr. Stewart's executors came second, and first in the next class for Breeding Sows, Mr. Swanwick's sow being put second.

Happily there were no cases of misstatement of age on the part of exhibitors of pigs discovered by the Veterinary Inspectors, who went through the unpleasant process of examination with their usual assiduity. All must rejoice that this, at one time serious evil, has been checked by the firmness of the Council in coming down upon offenders.

Report of the Judges.

The show of pigs was fully up to the average in quality.

The *Large Breed* was well represented, and the classes of both Aged Boars and Sows contained animals of the highest merit.

The same cannot be said of the *Small Black Breed.* The entries were small in number and poor in quality, and we are of opinion that as these pigs are so rarely bred, it is a question whether it is necessary for the Society to continue classes for them.

The *Small Whites* mustered much better, and the Aged Boar in this class was a pig of a very high standard. We wish here to remark that several pigs shown in these classes were of the old Middle Breed, and that though they are most admirable specimens of this useful sort, were not eligible to compete.

The *Berkshires* were well represented, and took the lead in point of numbers, and in merit also ranked very high. The class for Aged Boars and Sows brought some magnificent specimens, and gave the Judges some difficulty in selection. In both these classes the Judges held that some animals, though good pigs, did not possess the true Berkshire type, and especially in the want of firmness of flesh, and they considered such pigs disqualified in consequence.

The Judges cannot conclude without thanking their Steward, Mr. Foster, for the most kind and able assistance which he rendered them.

Alfred Ashworth.
John Angus Joseph Smith.

Cheese and Butter.

There were thirty-six entries of Cheese, and only twenty-two entries of Butter, in the four classes for Cheese, with prizes to the amount of 75*l.*, and two classes for Butter with ten prizes, amounting to 30*l.* The paucity of the entries, and the comparatively indifferent quality of the samples exhibited are somewhat remarkable, when it is considered that Derby is situated in a dairy country, and that there is such an extensive demand for good English cheese and butter, and that now for some time the importance

of attention to these products has been reiterated, and information as to modes of manufacture has been widely spread by the publications in the 'Journal' of this Society, and of the agricultural press. In many places in England, in towns, and even in villages in the midst of rusticity, it is often difficult to get milk, cream, and butter, for love or money; and the butter generally is badly made when it is procurable. The manager of a large hotel in Derby actually has all the butter he requires for the large consumption of the hotel from Normandy, not because it is cheaper, but because he can depend upon a regular supply of uniform quality. Mr. Jenkins has shown how much better they make butter in France and other continental countries, and supply the English with it and various dainty cheeses of cream and milk, which give such good returns. Fine butter, however, has been in no degree reduced in price by foreign competition. Good English fresh butter is as dear as ever, and almost any quantity of it could be sold. Many consumers now are compelled to use "preserved" butter, simply because they cannot get fresh butter. The same may be said of really good English cheese. This is dearer to the consumer than before the great American influx of cheese. Stilton and North Wiltshire cheeses make very high prices, with an increasing demand. From the show of Stilton cheese at Derby, not many leagues from Stilton—their *fons et origo*—it seems that the art of making these cheeses is being lost, and that the cheese- and butter-makers have lost heart, or do not care about the trouble and labour. No doubt many dairy-farmers send much of their milk to London and large towns, yet this is not a certain or constant channel, nor by any means the best means of making the most of cows. This is hardly the place for a lamentation, but it is mortifying to think of these neglected opportunities, and to know that practically there is an unlimited market at home for fine butter and cheese, and a large and growing demand for divers other things, such as poultry, eggs, fruit, and vegetables, and best quality bacon, for which from 10*d.* to 1*s.* per lb. is charged to consumers, in spite of the enormous importation from America, and that this does not seem to be realised by the English producers.

The useful lessons taught by the working-dairy, which Mr. G. Mander Allender has managed at the last three Royal Shows, and at other Shows in England, and the numerous inventions of many kinds of economical and labour-saving character in connection with all the processes of dairy-work, must give, it is thought, a great stimulus to the improvement and development of cheese and butter-making. The Council of the Society contemplate an important extension of the exhibition of working-dairies, and the appliances connected with this

industry at future Shows, and desire to test the full advantages of the various Separators, and bring the best within the reach of all classes of dairy-farmers.

A most interesting exhibition of cows, butter, cheese, and dairy appliances of all kinds, was held at Ghent, in Belgium, from the 10th to the 14th of July last, under the auspices of the *Société Agricole de la Flandre-Orientale.* The number and value of the prizes, and the general elaboration of the prize-list, show that this Society realises the importance of dairy industry—*Industrie Laitière*—and sets to work with energy and liberality to encourage it. The numerous entries in all classes indicate that the Belgian and Dutch farmers fully appreciate the opportunities offered by this exhibition. For the best "collection" of three cows, Dutch, Flemish, or cross-bred, there were thirty-four entries. For the best collection of two cows, thirty entries. For the best two Shorthorn cows—*Race de Durham*—there were ten entries. There were several other well-filled classes of cows and heifers. For butter, the entries were ninety-one; for cheese of various kinds, forty-five; and a long list of all kinds of appliances. Of this, the first Show of the kind, the 'Indépendance Belge' writes:—"Such is the exhibition at Ghent. It foreshadows a complete revolution in one of the most important branches of our agriculture."

Mr. Hardy, Mr. Brough, and Mr. Saint, all of Derbyshire, took the prizes for cheese. Mr. Gould, of Cheshire, showed the best ½ ton of cheese, taking 20*l.*; and Mr. Dainton, of Cheshire, received the second prize of 10*l.*

In the first Butter Class, Mr. Milner, of Derbyshire, was first, Mr. Sampson, of Sheffield, second. In the next class, Mr. Flanders, of Derby, was first, and Mr. Milner second.

Below are given the Reports of the Judges of Cheese and Butter.

Report of the Judges of Cheese.

The show of Leicester and Derby *Cheese* was exceedingly satisfactory, considering the early period of the season at which the exhibition was held, many of the lots being so nearly equal as to cause considerable difficulty in awarding the prizes. The method used in making factory cheese naturally tends to ripen them, and consequently this description was placed somewhat more advantageously than farmers' cheese in the competition; but in consequence of this forced ripeness the factory-made cheese requires speedy consumption; whilst the farm-made dairy cheese, being ripened gradually, keeps better for the autumn trade, and also improves with age. The Stilton exhibits were a *decided failure,* and we felt that to award prizes for so inferior a sample of this fine class of cheese would be an injustice to the Society.

Signed on behalf of the Judges,

JOHN STAFFORD.

Report of the Judges of Butter.

In handing in our awards as Judges of the *Butter* exhibited at this Show, we beg to remark that we were somewhat surprised and disappointed at the limited number of entries. We certainly expected, from its being in a large dairy district, a much greater competition. We consider the make generally as fair, but not extra choice; some allowance, however, should be made on account of the exceptionally hot weather, which has a prejudicial effect upon butter, when it is exposed after leaving the dairy.

JAS. WATSON.
BENJ. BRINDLEY.

BEES

Clearly come within the definition of "live-stock," and therefore are within the jurisdiction of the Stewards of Stock. Fortunately they need not "handle" them; nor are the Veterinary Inspectors required to look in their mouths. They are the only live-stock that are shown in a natural state, simply because they cannot be fattened. Bees are desirable in a Royal Show-yard, as living, moving, and stinging incentives to industry; as being profitable to keep, and as one of the minor cultures which may well be added to every farm-house, and as being immensely useful in the fertilisation of the blossoms of fruit-trees and fruit-bushes, and the flowers of various cultivated plants. Mr. Darwin, in his "Cross and Self-Fertilisation of Plants," says:—"The extraordinary industry of bees, and the number of flowers which they visit within a short time, so that each flower is visited repeatedly, must greatly increase the chance of each receiving pollen from a distinct plant." * In this work of Mr. Darwin's the result of many experiments is given, showing the effect of insect agency; and a list of plants, among which are certain sorts of clover, which, when insects—hive-bees among others—are excluded, "are either quite sterile or produce, as far as I could judge, less than half the number of seeds produced by unprotected plants." The diagrams that were exhibited in the shed near the bee-tent, at Derby, clearly illustrated the action of bees in this direction, and depicted the arrangement of their proboscides for the extraction of honey from the nectaries of flowers, and the manner in which the pollen of plants is conveyed by them.

This exhibition of bees was organised by the British Bee-keepers' Association, who offered three prizes for the best exhibition of Hives and Bee appliances, all of which were taken by Messrs. G. Neighbour and Son. The representative of this Association gave interesting explanations daily of the various hives

* 'The Effects of Cross and Self-Fertilisation in the Vegetable Kingdom,' page 424. By Charles Darwin, M.A., F.R.S.

and their advantages, and dilated upon the profit and utility in many ways derived from keeping bees.

Some description has now been given of each division of the Show specially belonging to the live-stock department. It only remains to offer many thanks to those who have given valuable assistance to the compiler of this Report—notably Mr. Dent Dent, Mr. Charles Howard, and Mr. Bowen Jones—and to express sincere regret that my term of office has come to an end. Bright with innumerable courtesies from colleagues, officials, exhibitors, and servants, with not a single unpleasant incident, this period of stewardship has been one of unmixed satisfaction and of infinite instruction.

XXXII.—*Report on the Exhibition and Trial of Implements at the Derby Meeting.* By Robert Neville, of Butleigh Court, Glastonbury, Senior Steward.

On retiring from office as Steward of Implements, I am happy in being able to congratulate the Society on having held a most successful Show this year. The weather was quite perfect. Not a drop of rain fell; and dry weather, to the implement department especially, not only during the Show, but both before and after, is an untold blessing.

The people of Derby did all in their power to make things go well, and they succeeded. Two tramways, both running close to the yard, were a material help to the public, and their dividend this half-year should be a good one.

There was an increase in the number of compound engines in the yard, and there can be no doubt that this form of engine will steadily and surely come into more general use. Up to now people have been well content with the performance of the ordinary high pressure engine, and glad at being able to achieve so good a result by so simple a machine; but now that every one is more familiar with steam, the obvious economy of compound engines, and especially of late, since they have been so much simplified, is gradually working on the minds of steam users, who, as occasion offers, are almost invariably adopting them. It is to be hoped that the Society will before long have trials of compound agricultural engines, conducted so that they may truly compare with the Cardiff trials.

The Working Dairy was again a great attraction, and there can be no doubt that the continued efforts of the Society in this department have helped to awaken people to the backwardness

of England in dairy matters, and especially to the fact that it is no more trouble to make good butter than bad; indeed, if anything, less; ignorance and prejudice being the fostering causes of the misapplied labour of so many professional butter-makers. The daily lectures of Dr. Voelcker were highly appreciated.

In another compartment, but under the same roof, were the Separators; but as the Working Dairy forms the subject of a special Report, no more need be said about it here.

The trials of self-binding reapers began on Monday, Aug. 8. The crops and fields were all that could be desired, but the weather was showery and unsettled. This made the Judges' difficult work still more difficult; but owing to the number of machines which actually came into the field being so much smaller than that entered for trial, and as, by universal consent, the trials in beans were given up owing to the unripe state of the crop, our work ended on Wednesday evening, Aug. 10.

The awards of the Judges were as follows:—

The M'Cormick Harvesting Machine Company, Chicago, Illinois, U.S.A., the Gold Medal for their String Sheaf-Binder.

Samuelson and Co., Banbury, Silver Medal for their String Sheaf-Binder.
The Johnston Harvester Company, 1 and 2, Chiswell Street, London, E.C., Silver Medal for their String Sheaf-Binder.
} Equal.

H. J. H. King, Newmarket, Stroud, Gloucestershire, Highly Commended for his principle of separating and tying sheaves.

XXXIII.—*Report on Miscellaneous Implement Awards at Derby.* By JOHN COLEMAN, of Riccall Hall, York, Reporting Judge.

Judges.

J. W. KIMBER, Tubney Warren, Abingdon. W. SCOTSON, Aigburth, Liverpool.
JOHN COLEMAN, Riccall Hall, York.

THE visitor to the Show desirous of studying agricultural mechanics must have been well pleased at the reduced size of this portion of the Exhibition as compared with meetings prior to the alteration of fees, its compact arrangement, and especially its admirable classification, by which machinery of a similar character or for the same object was grouped together, thus greatly reducing the labour of inspection, and affording opportunities for comparison, of great importance to intending purchasers. It is satisfactory to learn that, nothwithstanding the wide-spread depression which has prevailed so long, and which, though somewhat mitigated, is still felt severely, more business was done than could reasonably have been expected; but

this fact assumes a less healthy appearance when it is known that the purchasers were to a large extent landlords who have become occupiers, from the absence of demand for their land, which prevails to an alarming extent in some of the Southern and Midland counties. It would be a more serious matter than it is for the English implement-makers if their trade were confined to the home demand; but, fortunately for them and the country generally, they have, notwithstanding foreign tariffs, secured a large share of the European trade. As an illustration of this fact, I may mention that one large company, which has become especially famous in connection with harvesting machinery, stated in their last half-yearly report that, out of unexecuted orders amounting to fifty-six thousand pounds, only seven per cent. of such orders were for the home trade. This is probably a somewhat extreme case, but our leading firms have been greatly dependent on their foreign connection for orders during the times of trial through which we are passing, and of which we may hope to have seen the worst. In order that a foremost place should continue to be held, and the competition which is so keen from our Transatlantic friends successfully met, it is absolutely necessary that we should have not only the best-constructed implements, but such as are most suitable and economical in working for the special requirements of our constituents. It is, therefore, worthy of remark that at Derby there were at least two departures from old lines, and both hail from the land of Columbia. I allude to riding-ploughs, exhibited by two well-known firms, whose exhibits are described (pp. 608–614), and a corn and small seed drill combined, shown by James Coultas, which is constructed upon the lines of the American force-feed drills, which, varying in detail, are identical in principle, and are a wide departure from the disc and seed-cup with which we have hitherto been contented. Mr. Coultas was led to adopt this arrangement, because he found that he could not sell the English drill to foreign customers. I hold a strong opinion that if a careful trial were made, the deficiencies of the disc and seed-cup would be so apparent, that for home use the force-feed principle would be adopted. It will be remembered that English implement-makers generally declined to exhibit at Philadelphia in 1876, and missed the opportunity of comparing and testing their machinery with that of the States, for which, as regards drills, there were unusual facilities; for the series of trials that were organised by the jury and carried on in the Agricultural Department were far more complete and exhaustive than those at Bedford in 1874, which furnished the idea. At the latter the variation in the discharge from each coulter of the drills was tested by fixing small bags

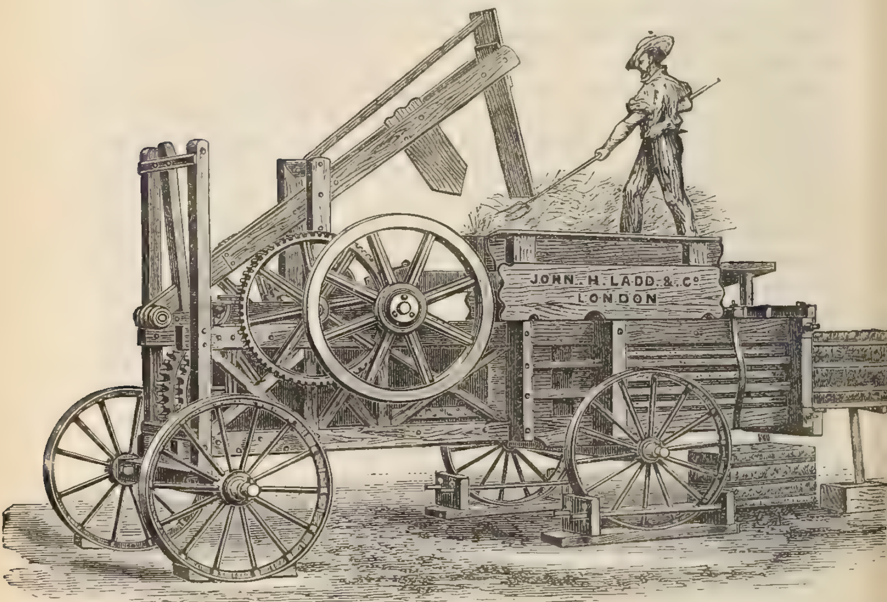
on the spouts and running the drills along a level road. At Philadelphia the experiments were extended by running the drills in different positions, representing severe gradients on hill-sides and equal ascents and declines. In the report published in the 13th volume of this 'Journal,' in 1877, tables of results are given. A comparison of the best English and American drills, working on the level, shows that whilst Coultas's first-prize drill varied as to different coulters 7 lbs. 6 ounces per acre, the McSherry drill, sowing the same quantity of seed, only showed a range of 10 ounces. If such was the difference on the level, where the English seed-cups would discharge with their greatest regularity, I leave my readers to imagine what would have been the results if the English drill had been worked at an angle of 30 degrees to represent a hill-side; how much of the seed would have fallen outside the receiver altogether, and how great must have been the irregularity of discharge from the different coulters. Yet in the best American drills the variation was practically unappreciable. Thus, in the McSherry drill, when the right-hand side of the drill was elevated, the variation per acre between the minimum and maximum discharge was exactly the same as on the level, viz. 10 ounces per acre; and when worked in the opposite direction, *i.e.* with the left-hand side elevated, the difference was only fractionally greater, viz. 12 ounces per acre. In one other drill, made by the *Farmer's Friend Manufacturing Company*, the results were even more remarkable when compared with the discharge on the level, though the latter represented a variation of 16 ounces per acre; the total difference per acre in seed sown was only 4 ounces in one case and 2 ounces in the other, results that are marvellously accurate. I have alluded to this subject because it is probable that these remarkable facts have hardly obtained such attention as their importance deserves. Why should we continue to use an implement that is so manifestly defective when we can so easily obtain that which is superior?

The chief objects of interest at Derby were the exhibits in the Working Dairy, and especially the separators, of which an exhaustive report is made by Mr. H. J. Little, and the novelties for binding corn with string, of which a description will appear in the report of the trials to be published in the next volume. Beyond these exhibits there was so little of meritorious novelty available for notice under the new regulations, that after a careful inspection the Judges only made two recommendations for Silver Medals. These were awarded by the Stewards to Article 5420, Perpetual Baling Press, exhibited and manufactured by John H. Ladd and Co., of 116, Queen Victoria

Street, London, and to Article 5393, Guard for Circular Saw, exhibited and manufactured by R. W. Tayler, of Bury St. Edmunds, Suffolk. A short notice of these inventions may be of interest to those who had not an opportunity of inspecting them.

The Perpetual Press is an American invention, which was shown in its present identical form at Philadelphia in 1876. It was then described as Dederick's Hay-press, from the name of the Patentee. Fig. 1 will convey a correct idea of the exterior of the machine.

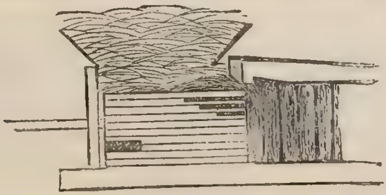
Fig. 1.—*View of the Perpetual Baling Press*, No. 5420.



It will be seen that the hay is fed into a hopper (Fig. 2) by the attendant, and that, at regular intervals, when the traverser is withdrawn, a fork or board descends and forces the hay into a chamber below the hopper, where it is subject to the compressing action of a reciprocating traverser. Fig. 3 represents the position of the hay after it has been forced down by the fork or board, preparatory to its being driven forward by the traverser. This combined action causes each section of the bale to be folded up as is shown in Fig. 4. The pressing is accomplished by a reciprocating traverser moving backwards and forwards underneath the hopper, which presses against the compact hay, and forcing beyond its traverse at each revolution all the hay

pitched into the hopper. The chamber into which the hay is forced is provided with steel springs, which retain all the hay forced beyond them, and prevent expansion backwards, when the traverser is withdrawn. The size of the chamber is $12'' \times 15''$, and this of course regulates the dimensions of the bale, which can be made of any convenient length (although the usual size is 3 feet) by the insertion in the hopper of light wooden followers with slots on their surface, through which the wires are passed for tying the bale as it passes through the chamber. The wires of proper length being first prepared, an attendant below passes

Fig. 2.—*Section of the Hopper of the Perpetual Baling Press.*



Figs. 3 and 4.—*Illustrating the folding action of the Perpetual Baling Press.*

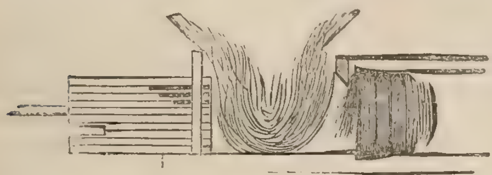


Fig. 3.

Fig. 4.

the wires through the slots in the followers, and brings the ends together on one side of the truss with pincers. The liberation of the truss from the discharge end of the chamber, by allowing some lineal expansion, tightens the wires. The mouth is adjustable, so that by turning a nut the bale is released or held, thus forming light or heavy bales as required. Two men are required to operate the machine, the hay being supplied on to a platform which is level with or slightly above the top of the hopper. One feeds the machine, whilst the other attends to the wiring of the trusses or bales.

It will be understood from the figures and description that the bale consists of a number of independent sections pressed closely together, so that, when the ties are removed, each section may be taken off without pulling the bale to pieces, and without that waste inseparable from the distribution of a homogeneous mass. This is a point of considerable importance. The

sections can be piled up as so many blocks ready for use, or the bale can be placed on end, and gradually reduced by the removal of consecutive sections. Considering the rapidity of the work there is very little waste.

The Judges weighed a truss $12'' \times 15'' \times 36''$, which scaled 1 cwt. 1 quarter 16 lbs., being about 42 lbs. to the cubic foot, whereas the exhibitors claim to, and probably could, compress 45 lbs. per cubic foot, which would allow 1 ton of hay to be packed within 1 ton measurement of 40 cubic feet. In a time test it was found that 3 feet 8 inches of hay was discharged in two minutes. As this weighed 191 lbs., and the work is continuous, it follows that the machine can bale in round numbers about $2\frac{1}{2}$ tons per hour. Whereas the Pilter Press, which makes a circular truss, and was awarded a Silver Medal at Kilburn, bales only 1 ton per hour, and costs 100*l.*, the Perpetual Press is catalogued at 275*l.*

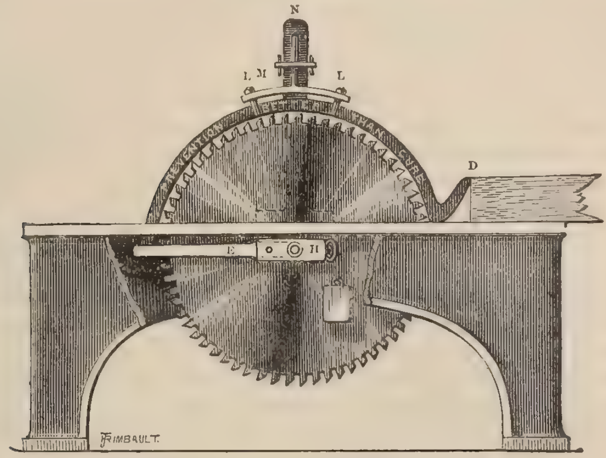
The Judges considered that this machine has merit and utility for the following reasons:—The rapidity of execution and the small cost of manual attendance; the peculiar way in which the hay is passed in sections; the simple action of the presser, minimising waste; and the advantage of the rectangular form of truss for stowage as compared with cylindrical trusses. It has yet to be seen to what extent, if any, such a machine may be applied to comparatively green hay in the fields. The exhibitor claims that such compression would prevent fermentation, even if the hay were packed in a much greener state than that in which it is ordinarily stacked, and this opinion was shared in by Mr. Scotson, one of the Judges, who is an extensive hay-seller, and who held a strong opinion that through its agency hay might be secured from the field in a greener, and therefore more valuable condition for many purposes than when stacked and sweated according to ordinary practice. The fact of the hay being so closely packed would, by excluding the air, prevent heating; moreover, the bales could be so stacked in barns or sheds as to secure ventilation between them. One machine, capable of pressing $2\frac{1}{2}$ tons per hour, could deal with the crop as rapidly as by ordinary stacking. The hands employed would be less numerous, and when the market is the destination, such a scheme seems very practicable. The wire rope or bands can be used over again until worn out.

Tayler's Patent Automatic Shield for Circular Saws.—The simplicity and efficiency of this guard commends itself. The figures which give the elevation and end view require (Fig. 5 and 6) but little explanation.

Fig. 5 gives a view of a saw-bench, broken away in front to show the means of attaching the safety shield, which is hung

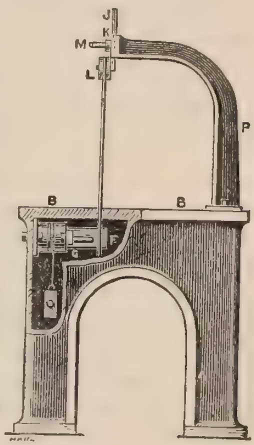
upon the stud H, so that the revolving arm E is held concentric with the saw, and is balanced by the counterpoise suspended in

Fig. 5.—*Elevation of Tayler's Automatic Shield for Circular Saws, No.* 5393.



the front. To the other end of the arm E is attached the shield, which is half circular, of steel, $1\frac{1}{2}$ inches deep, and the same thickness as the saw. At its front end is a projection or continuation, D, so formed that as the piece of timber to be cut approaches the saw, it causes the shield to rise and rest on the wood, ensuring safety to the operator, without perceptibly increasing his labour in moving the wood. The slight leverage from the counterbalance ensures the continuance of the shield on the wood, whilst its position over the saw is provided for by the guide-rollers LL, which are adjusted by means of a slide, M, and T bolt attached to a rigid bracket, N, which is fixed to the back edge of the table-top.

Fig. 6.—*End view of* No. 5393.



As soon as the timber has passed from the saw, the shield reverts to its original position, entirely covering the saw, and so remains until raised by the next piece of wood. This is of great practical importance, for the majority of accidents arise from careless handling of the pieces of wood returned to be re-

cut. These are often thrown back over the revolving saw, and if contact occurs, the wood is shattered, and the results are often very serious. A stopping-pin is provided, which ensures the shield reverting to its position after it has been raised for any cause by the man working the saw. When a quantity of similar work is on hand, the shield can be fixed in any required position by means of a locking catch. This, which the inventor considers a point of merit, strikes me as the only defect of the invention; for by prolonging the projection D on the end of the cover, the guard can be made to adjust itself automatically to timber of any scantlings, and the saw is thus entirely guarded and accidents are rendered practically impossible; whereas if the guard is fixed as suggested, a portion of the saw, according to the depth of the timber, is exposed exactly at the point where accidents to the workman handling the timber are most likely to occur. The apparatus can be applied to any make of circular saw. Regarding merely the amount of workmanship and material, the price of the apparatus, 5*l.* 10*s.*, appears high; yet, considering the extreme simplicity and perfect efficiency of the invention, its value to employers, owing to recent legislation, cannot be over-estimated, and renders it an investment likely in a very short time to prove highly remunerative.

In connection with this important question of guarding machinery, it is right to notice a safety cover for shielding emery wheels exhibited by J. D. Ashworth of Manchester. This was brought more prominently before the notice of the Judges, from their recollection of the fatal accident which occurred at the Liverpool meeting from the bursting of such a wheel. As far as could be judged from the appearance of the apparatus, no trial having been made, it seems likely to prove effective. It consists of a strong hood, formed of two cast-iron sides, bolted to the carriage of the wheel, and connected together above by wrought-iron distance-pieces, which would effectually prevent any portions of the wheel from flying, should it burst. It somewhat resembles the form of Carr's disintegrator, leaving only sufficient space unguarded to allow of the operator having the necessary access to the wheel.

Gang or Riding Ploughs were exhibited by Messrs. J. and F. Howard, of Bedford, and John Cooke, of Lincoln, firms that have achieved a large measure of success as plough-makers. As much interest was felt by the public in these novelties, at least as regards the English trade, it was determined by the Stewards to have them at work, and this was accordingly carried out on Mr. Matthew Walwyn's farm, in a field secured by Messrs. Howard for the exhibition of their steam-cultivating machinery. The land was very dry, and not in a favourable

condition for allowing of good work. Nevertheless, the implements of both firms, when once properly arranged, did fairly well. Messrs. Howard's wheels appeared too small to secure all the advantages which should result from the substitution of a rolling for a sliding action, but this is a detail that admits of ready alteration. No accurate trial was made, as the Judges considered that neither of the machines was sufficiently perfected to merit a Medal.

In Messrs. Howard's Gang and Multiple Ploughs, a new and ingenious arrangement for lifting the ploughs out of work has been introduced, by the application of a brake-arm connected with the crank-shaft to the rims of the travelling wheels.

The same result is obtained by a more complicated action through friction-bands acting on grooved friction-wheels, which are placed on the hub of the travelling-wheels. When, therefore, by a leverage from the driver's-foot, the bands are sufficiently tightened, the revolution of the wheel acts on the crank-axle and lifts the plough out of ground.

It will be understood that the travelling-wheels are mounted loosely on stud axles, carried by crank-arms attached to a hollow cross-shaft B. This shaft is free to turn in bearings carried by the plough-frame, to the inclined cross-bar of which the ploughs are attached.

The side beams of the plough-frame are connected together in front by a cross tie-rod, C^1, which serves also for the fulcrum, for the rocking-frame E, to which the draft-pole E^1 is secured.

The hollow shaft B is fitted with a rod, F, which projects through its opposite ends, and has attached to it the elastic metallic friction-bands F^1 F^1. Grooved friction-wheels, A^1 A^1, receive these bands. Keyed to one end of F is an arm, F^2, which carries a stud-pin to receive one end of the friction-band F^1, the other end being similarly attached to the extremity of the rod F. The tightening of the friction-bands upon their wheels is effected by a treadle-lever, F^3. This lever has for its fulcrum a pin or rod at the front of the framing, and by means of a link, F^4, which is jointed to a short arm, F^5, keyed to the rod F, axial motion is imparted to the rod F, when pressure is put on the treadle-lever, and the bands are thereby caused to grip their respective wheels. In so doing, the forward motion of the wheels causes the frame to be lifted, and at the same time gives the hollow shaft B a quarter turn, or thereabouts, in its bearings. Figs. 7 and 8 (p. 610), which give the elevation and plan of a three-furrow plough, will explain the mechanism described.

The draft-rod E^1 is extended rearwards, to carry an overhanging bracket, E^2, from which depends a chain, E^3, attached to an arm, B^1, keyed to the hollow shaft B. When this shaft is

rocked in its bearings, on the application of the brakes, the arm B[1] will be caused to pull upon the chain, draw down the rear end of the draft-pole, and with it the front of the frame C, so as to bring the ploughs into the best position for entering the ground. B[2] is a hand-lever rigidly attached to the hollow

Figs. 7 and 8.—*Elevation and Plan of Messrs. Howards Gang Plough,* No. 4416.

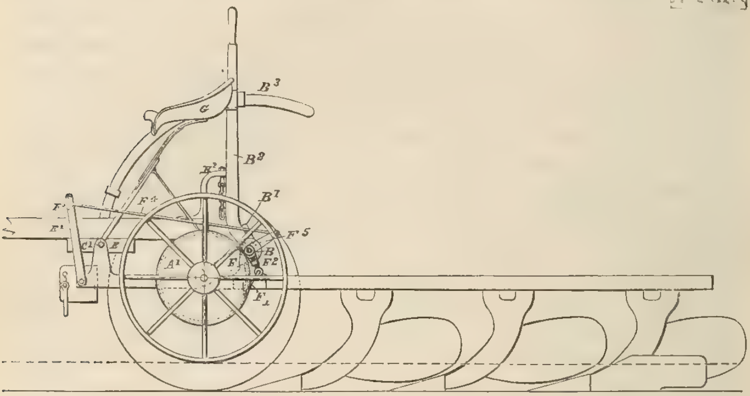


Fig. 7.—Elevation.

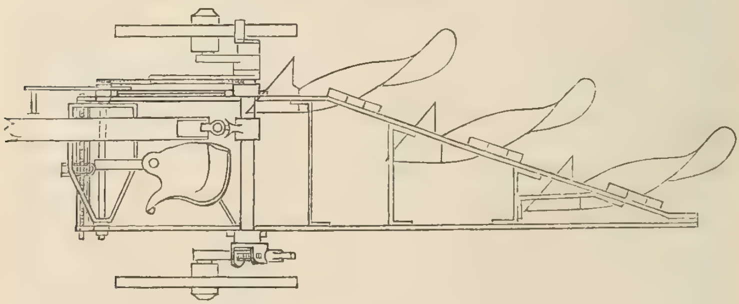


Fig. 8.—Plan.

shaft B, and slotted to move over a sector, B[3], attached to the cross tie-bar C[1]. Collars are fitted to this sector to form stops for limiting the motion of the lever, and consequently of the shaft B in its bearings.

It will be understood that the plough may be held up out of work simply by the cranks being thrown beyond the vertical line, the weight of the plough at that time assisting to retain it in its raised position.

To lower the plough into action, the attendant pulls over the lever B[2], and the plough will then descend by its own weight,

its downward movement being checked by the attendant through the hand-lever, which, coming into contact with the fixed stop, on the sector, limits the descent of the implement.

Figs. 9 and 10 show a modification. In this case the brake is applied to one travelling-wheel only, by means of an iron block acting on its periphery, and centred upon the solid shaft

Figs. 9 and 10.—*Elevation and Plan of a modification of Messrs. Howards' Gang Plough.*

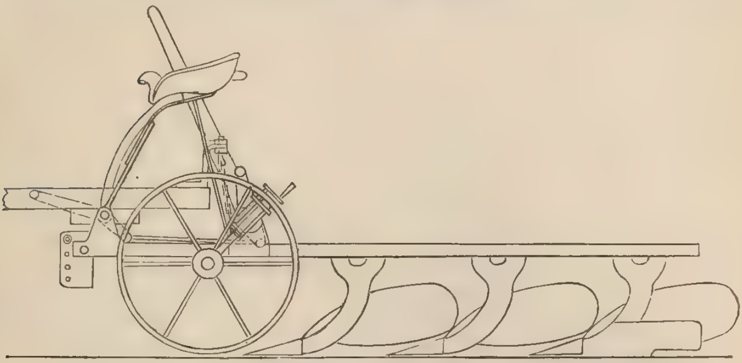


Fig. 9.—Elevation.

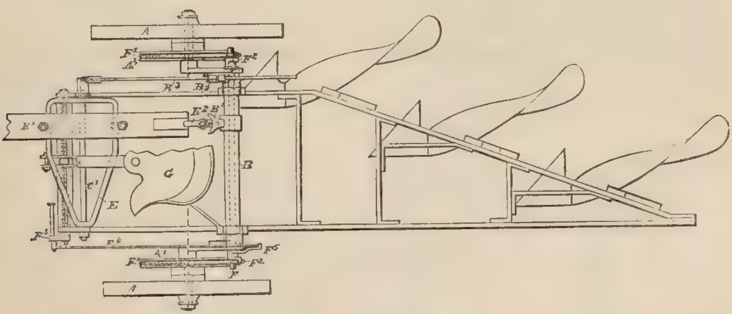


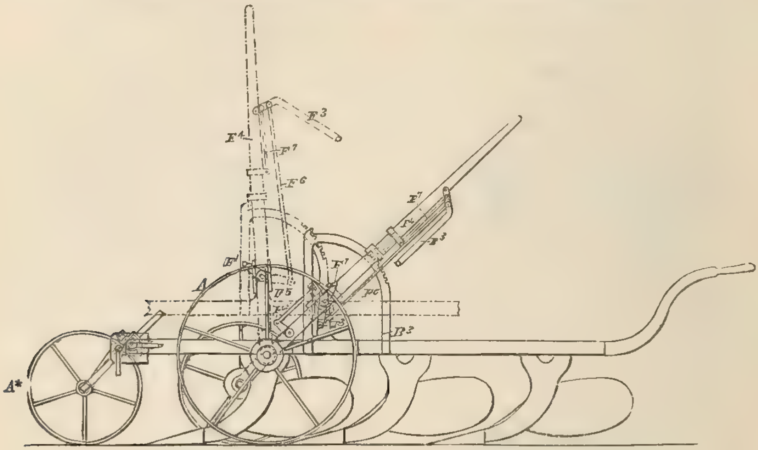
Fig. 10.—Plan.

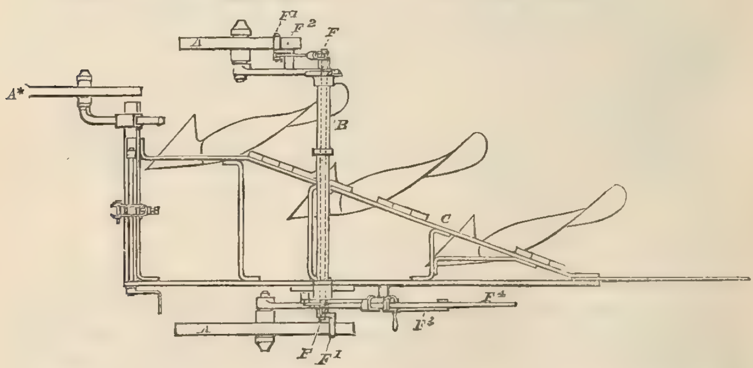
or axle of the implement. This brake is worked by a treadle-lever very similar to that already described. The other end of the shaft has a screw adjustment, by which the attendant can regulate from his seat the depth of the work whilst the implement is travelling.

Figs. 11 and 12 (p. 612) illustrate another modification of the lifting apparatus applied to a three-furrow walking-plough. The crank axle B is connected to the plough-frame C, as in the preceding examples. A leading wheel, A*, runs in the bottom of the furrow ; one of the travelling-wheels A is also in the

furrow, but it does not necessarily touch the bottom of it, but may run clear above it. The land-wheel is mainly relied on for lifting the plough out of work, and in ordinary ploughing the brake on one wheel would give sufficient bite. The brakes F^1 are brought into action by means of the hand-lever F^3, which lever is mounted on the side of a hand-lever, F^4, having for its fulcrum the rod F, which passes through the hollow shaft B.

Figs. 11 and 12.—*Illustrating a modification of the lifting apparatus applied to Howards' Three-furrow Walking Plough.*





F^2 are a pair of arms keyed to the rod F, and serving to carry the brakes F^1. An extension of one of these arms, as at F^5, connects with a link, F^6, which is pivoted to the hand-lever, F^3. By moving this hand-lever, the catch is first released from the notched sector, and the brakes F^1 are then caused to press upon the periphery of the travelling-wheels A A, and thereby effect the lifting of the ploughs out of the ground.

Pendant from the hand-lever F^3 is a link, F^7, which is connected with a block that slides upon the lever F^4, and carries a tooth that engages with the notched sector B^3. By the depression of the hand-lever F^3 to take off the brakes, the tooth of the sliding-block is caused to take into the notched sector, and thus the plough is locked in its raised position. The hand-lever F^4 enables the attendant to lower the plough from its raised position to the ground, the disengagement of the catch from the sector being first effected by the raising of the hand-lever F^3.

Some general idea of the form of *Cooke's Gang Plough*, which to English experience is an equally novel implement, will be gathered from Fig. 13, p. 614. The plough consists of a strong main beam, composed of angle-iron and wood, bolted and riveted together, and to this is attached by large screws another beam of iron, carrying the front frame. This secondary beam is thus adjustable according to the width of furrows that are desired. This is similar in character to the double plough made by this firm. Between and somewhat above the beams in front the pole is attached, being carried on a pivoted bar or plate about 2 feet from its lower end. The pole rocks loose and vertically on this plate, and the lower end terminates in an iron shoe and a bar, which is held in position horizontally in a wrought-iron pocket, by means of a pin dropped through holes in the pocket and corresponding slot-holes in the shoe. By this arrangement the pole can be adjusted sidewise to suit different horses, and for securing wide or narrow furrows. According to present arrangements, the pole is necessary in order to steer the plough. Two, three, or four horses can be yoked abreast, as required.

Towards the front end of the frame the two large carrying-wheels are fixed on sliding bars across the frame in suitable clasps and holdfasts. They are similar in size, viz. 36 inches in diameter. The furrow-wheel is raised or lowered in the ordinary manner, or by means of a screw attached to the wheel-standard within the driver's reach. The land-wheel is raised and lowered by means of a lever actuated by the driver and provided with a spring-catch working in notches on a quadrant, so that the wheel can be held in any required position. This lever further serves to throw the plough in and out of the ground, and to raise it clear of the ground for travelling or turning at the land's end. All that is necessary in order to raise the frame clear of the ground is for the ploughman to push the lever down to the lowest notch of the quadrant, which so alters the crank-axle carrying the land-wheel that the latter is brought to a lower level than the share points. The same lever also operates a cam or arm fixed on the cross-bar of the land-wheel, which depresses the lower end of the pole and throws up

the opposite end; so that when pulled down by the horses the hinder part of the plough is carried round entirely clear of the

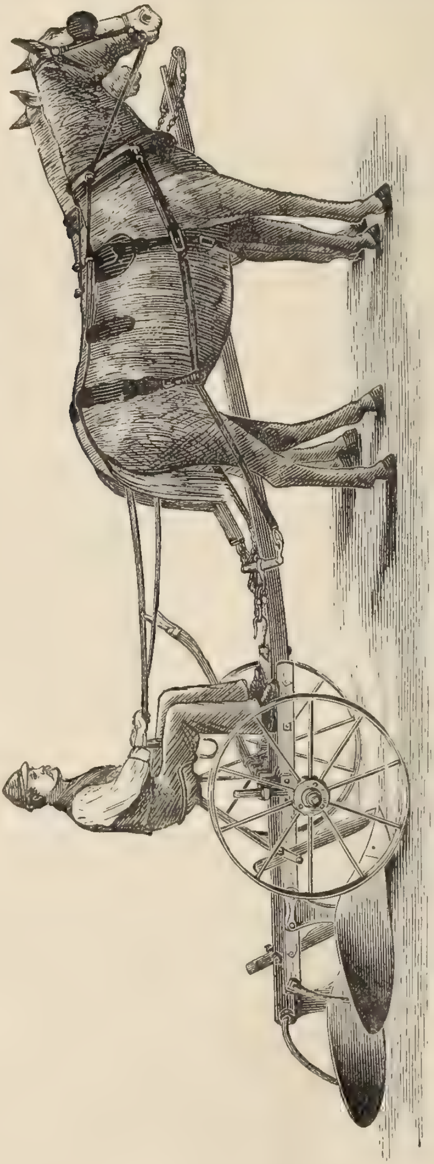


Fig. 13.—*Cooke's Gang or Riding Plough.*

ground. The furrow is always on a level with the bottom of the share points, and has only to be altered for setting out the ridges

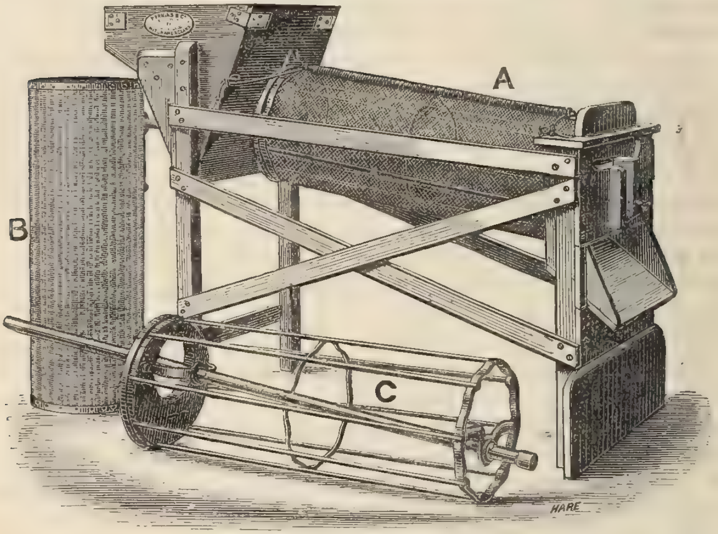
or for travelling on the roads. The driver's seat is fixed between the wheels and slightly behind the axles; and the intention is so to balance the apparatus over the axles, that the weight shall be entirely carried by the wheels, and as little as possible taken by the sole of the ploughs. Comparing the appearance of this plough with the best form of American Gang Plough, it appeared to me that the ploughs were too far behind the axle for securing minimum draught; and if the ploughs could have been brought forward, the balance would be simpler, the draught lighter, and the driver could see the work whilst guiding his team. It is possible that larger driving-wheels may be found desirable. They have half-rounded tyres three inches wide, with loose metal bushes, which are readily renewed. The plough is strongly made and suitable for a variety of purposes. The price is 15*l.*

Messrs. Perkins, Paternoster and Burlingham, of Hitchin, have made considerable improvements in their Corn Screen. The original polygon form is now replaced by a circular frame, which is made to revolve eccentrically, thereby securing a much more efficient action, which is a combination of a rotary and longitudinal motion. Another great point is, that the frame is capable of carrying various screens, which are easily removed and replaced, and which cost from 12*s.* to 30*s.*, according to size. The screens are stamped out of metal plate, so that the openings cannot vary in size. Wove wire screens are also used; and a patent corrugated barrel, similar to that originally employed by Pernollet, can be supplied, which is useful for the removal of round seeds, and especially hariff ("Goose-grass" or "cleavers"). This screen has a number of indents on its inner surface. These receive the weed seeds, and carry them round till overcome by the force of gravity. They fall into a sloping receptacle in the lower portion of the screen, whence they are discharged.

A Corn Elevator, which takes but little power, can be attached; and for large operations, such as maltsters' business, it effects a considerable saving of labour. The great feature in the new screen is the circular frame, which receives any one of the screens, the exchange being made in a few seconds. The prices for machines with only one barrel range from 3*l.* 10*s.* to 7*l.*, according to size desired. Fig. 14 (p. 616) shows the machine complete (A), with the eccentric frame (C), and an additional screen for dressing barley (B). The Judges tried this screen. The material they had at command was not suitable, but it enabled them to decide that the screen was very efficient as to separation, but rather slow in operation. The following details as to construction may be of interest. The screen frame is of deal, simple as to construction, with cross braces at the side to give rigidity.

The band-frame is made of wrought-iron bars riveted to wrought-iron rings. The feed-end or head is constructed of wood, and is made like two heads screwed together, so that the cylinder slips over one and butts against the other, and thereby makes the joint secure. An iron bracket, screwed to the head, forms the centre-bearing for the spindle. The ring at the delivery end is made of cast iron, with the boss out of the centre, which gives the eccentric motion to the spindle. The cylinders are made of perforated iron, riveted together ; they are

Fig. 14.—*View of Messrs. Perkins, Paternoster, and Burlingham's Patent Eccentric Corn Screen.*



readily slipped on to the frame, and secured to the wood head by screws. The iron bars of the barrel-frame act as lifters to the corn, and help to keep the corn in motion whilst it is in the barrel. The round-hole cylinders are corrugated, to further aid in this movement. The cleaner consists of a thin wooden rod, covered with a spiral wire ; it is kept in place by cords attached to the two ends and to the wooden frame. The cords allow great freedom of action to the cleaner, rendering its action very efficient, without much friction. The reason for corrugating the round-hole barrel and not the long-hole one is that the latter is much more difficult to clean, and requires the cleaner to touch all the way round ; whereas in the round-hole barrel the vibration of the cleaner over the uneven surface is quite sufficient.

Coultas' Force-feed Drill, though not an absolute novelty,

inasmuch as it was shown at Carlisle, is such a departure from the ordinary mechanism of English drills, that a short description is desirable. And it may be as well to explain what is meant by a positive Force-feed. It is such an arrangement as insures that, whenever the feed-cups are filled with seed and the drill put into motion, an absolute and regulated quantity of seed shall be discharged from each cup; and this must take place in whatever direction and at whatever pace the drill travels. Thus, inasmuch as the seed is always above the means of discharge, there is little or no practical difference in the delivery, whether the drill is travelling on the level or on a hill-side. There are several different arrangements for securing positive feed.

Fig. 15.—*Seed-wheel set for large Quantities.*

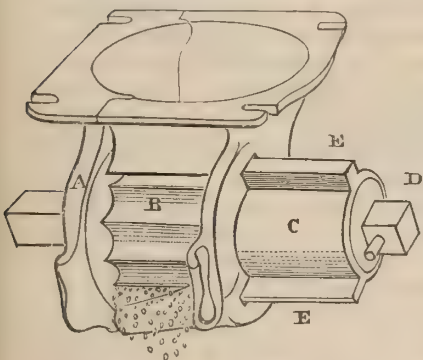
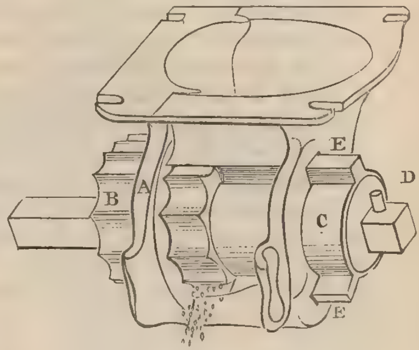


Fig. 16.—*Seed-wheel set for small Quantities.*



In Messrs. Coùltas' drill, change-wheels are entirely done away with, and the quantity of seed is regulated by operating a lever which causes the feed-shaft to slide to right or left, thereby bringing more or less surface of the feed-wheels to operate on the grain. This will be best understood by reference to the foregoing illustrations, Figs. 15 and 16, which show the position of the seed-wheel set for small or large quantities respectively.

On the left-hand side of the feed-cups is a scalloped ring, A, which revolves with the fluted feed-wheel B, but it is quite independent of the seed-shaft to which the feed-wheel is attached.

The hub or follower, C, on the right-hand side of the cup, which does not revolve with the feed-shaft, has a flange, E E, at the top and bottom, which completely closes the aperture of the feed-cup when the hub is brought into the cup. By moving the feed-shaft right or left, all the feed-wheels, being fixed on the spindle, are equally influenced, and the amount of seed sown depends upon how much of the feed-cup is occupied

by the feed-wheels and how much by the flanged hub. As it is possible to fill the whole space with the seed-wheel by moving the spindle very much to the right, in which case the maximum quantity is sown, so it is equally possible to close the openings altogether, and between these extremes minute gradations are possible. There is a small lever attached to the feed-shaft, held by a thumb-screw. When this is loosened, the lever can be actuated to alter the feed as described.

There is a scale on the back of the hopper, with figures to indicate the quantity of each of the different kinds of grain to be sown per acre. Moving the lever alters the indicator (which is fastened to the feed-shaft) to any desired point, and the position can be secured by tightening the thumb-screw. The revolutions of the seed-shaft are registered through a simple arrangement of geared wheels, working an index on a disc. In this way the land actually drilled is measured, and is a useful check upon the industry of the operator; one motion raises the coulters and throws the seed-shaft out of gear. In front of the seed-box is a small drill for sowing clover and grass seeds. The whole apparatus is strong and simple, and I am satisfied that the delivery will be found very much more accurate than with the old disc and seed-cup arrangement.

Great interest was exhibited in *Darby's Steam Digger*, which was tried at Carlisle, and reported on by Mr. R. Neville, our Senior Steward this year. At Derby there was no opportunity for a trial; and as the machine, though improved in detail, was in the main identical with the previous exhibit, no great advantage would have followed. As it was, it attracted an admiring crowd, whilst it kept revolving the digging tines, showing the character of the motion by which such powerful results are produced. The improvements made since the Carlisle Meeting of 1880 are as follows:—

1. The steerage apparatus is now attached to the front broadside of the digger whilst digging, instead of trailing behind over the dug ground. The discs, which were intended to serve the double purpose of breaking the clods and aiding the steerage, have been abandoned, and two wheels are now used for steering only.

2. A ready means of adjusting the depth of the digging has been introduced, which enables the steersman to regulate the depth without stopping the machine.

3. The cranks conveying motion to the digging tools have a larger throw, causing the spits of earth to be turned over with greater certainty.

4. The driving-pins in the wheels, used whilst turning, have been replaced by clutches, which can be used by the steersman

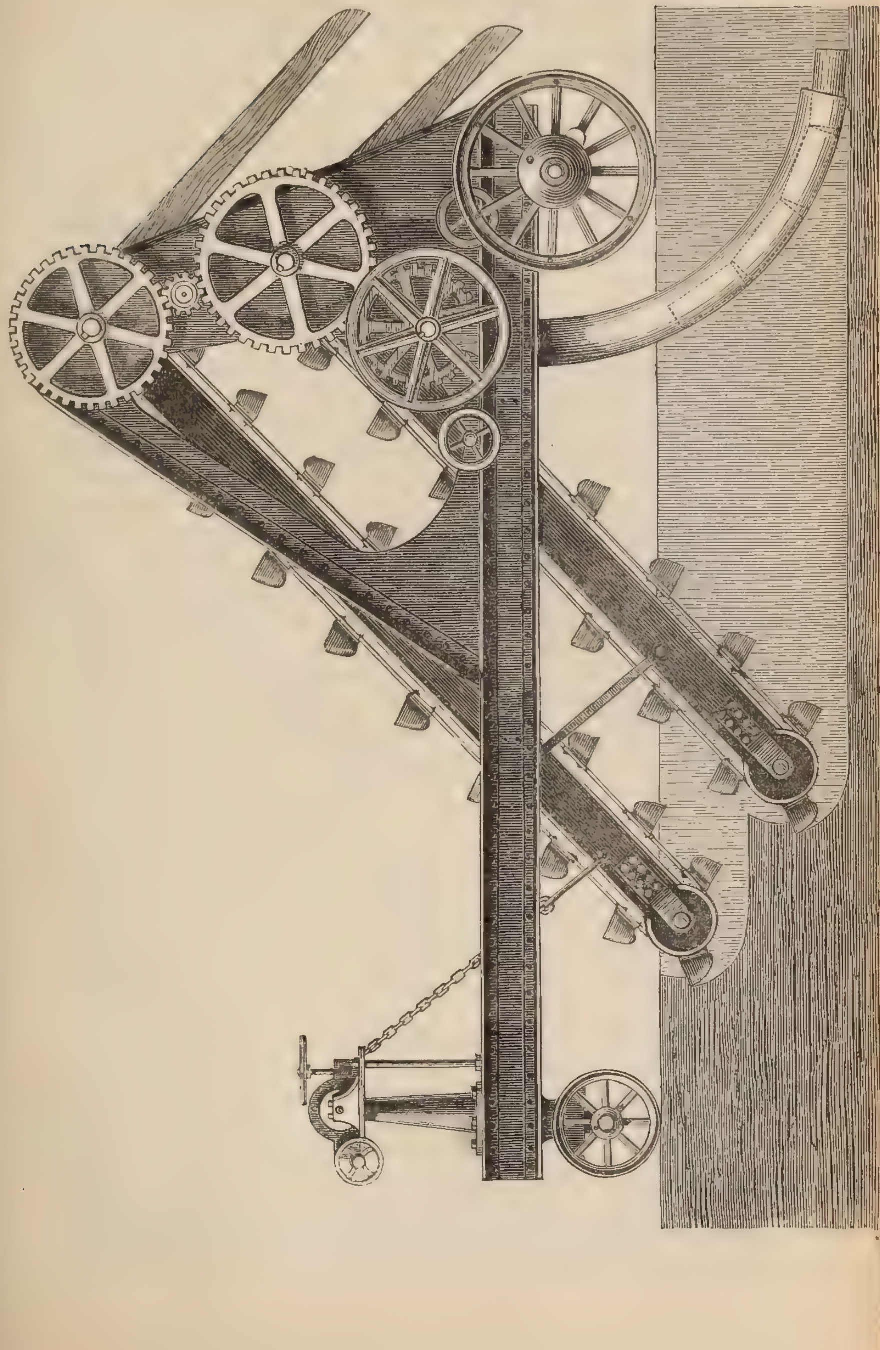


Fig. 17.—*Elevation of the Victoria Foundry Company's Draining Machine, No. 4918.*

with greater ease, and by them he has the machine more perfectly under control. The machine is now made by Messrs. Wimshurst, Hollick, and Co., of London. That shown at Derby was sold to a gentleman in Essex, and Lord Herries, a Yorkshire landowner, has purchased one of similar construction.

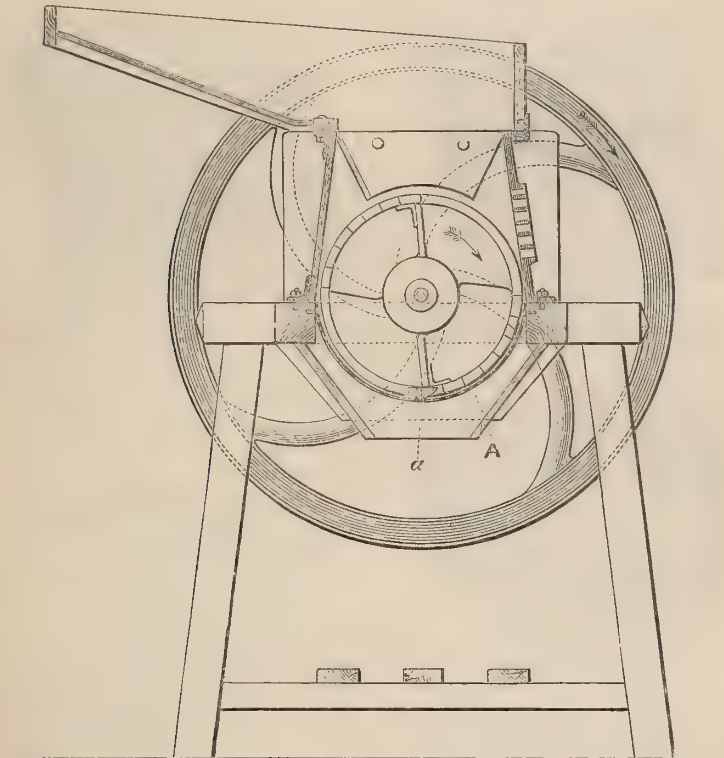
A great novelty in the form of a *Draining Machine* was shown by the Victoria Foundry Company, of Newark-on-Trent. This was manufactured by Abbot and Co., under Robson and Hardman's patent. The nature of the invention will be understood by the illustration (Fig. 17, p. 619), which gives a side view of the apparatus.

The motive-power is a wire rope from an ordinary ploughing-engine fixed on the headland. The drain is excavated by a series of revolving buckets cutting to the required depth and fall. These buckets are sharp-edged and very strong, as they have to act as scoops to remove as well as carry the soil. They are driven from the hind travelling-wheel by a series of toothed wheels. Under the machine is a pipe-conductor, by means of which the pipes are laid in the drain in front of the shoots, which deliver the soil cut out of the drain and brought up by the elevators, so as to cover up the pipes and fill the drain. This is very ingenious, and, provided the proper fall can be ensured, which has always been a great difficulty with draining-ploughs, this machine may prove of great value. The lower elevator, which takes out the bottom of the drain, deposits the material first, thus replacing the soil in the same relative position as it is removed. This is not always or usually desirable, and, if necessary, the process can be reversed. The frame is composed of strong iron plates, to which flange-pieces are riveted. The motion is necessarily very slow. This machine was not in a sufficiently perfect state to admit of a trial, a matter of regret, as nothing in the way of mechanical aid to suffering agriculture at this juncture can be conceived as more valuable than a really efficient labour and money-saving drainage tool. Without a very exhaustive trial, it is impossible to pronounce any opinion upon its present or possible future utility. The price in the Catalogue is 390*l.*

Messrs. Hornsby and Sons, Limited, showed a novel Turnip-cutter, which actually cuts the last slice, and avoids a certain waste which has occurred hitherto, owing to the last portion passing into the basket—a large piece, all, or nearly all, rind, and which is in consequence refused by the sheep and wasted. The illustration (Fig. 18) will explain the novelty, viz. the addition of a perforated guard or shield, A, fixed underneath the barrel, so that any piece that may escape uncut from the front cutting-plate is prevented from falling into the basket with the

cut roots, and is carried round to the hopper again, to be forced through the knives by other roots. The action is perfect, and the result is a great practical improvement in the economy of cutting up roots. Messrs. Hornsby state that in ordinary barrel machines a thin slice in every three out of five roots is wasted, and this waste, when properly passed through the knives, would

Fig. 18.—*Section of Messrs. Hornsby and Sons, Limited, New Patent Turnip-cutter*, No. 5314.



equal the feed of five sheep in every hundred ; and, taking the cost at 6*d*. per head per week, effects a saving of 2*s*. 6*d*. per 100 sheep. I do not know by what series of experiments such a startling result was reached. Allowing for its being somewhat in excess of actual facts, there can be no doubt that the uncut portion as it comes from ordinary machines is not eaten ; and when cut up, as it must be in this machine, it will be eaten, and to this extent the invention is practical and important.

In the Report of miscellaneous exhibits at the Kilburn Show

a short description was given of the *Malleable Iron Driving Chains* (Ewart's Patent), as improved and manufactured by Mr. Francis Ley, of the Vulcan Iron Works, Derby. At the Derby Show these, in various forms, and other novelties were exhibited, and the Judges desire to call particular attention to two forms of Belt-fasteners (Bachmann's Patents). The first of these,

Figs. 19 to 22.—*Illustrations of Bachmann's Patent Belt Fasteners*, No. 4923.

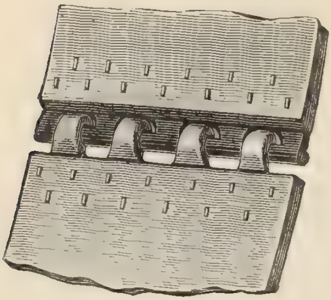


Fig. 19.—Under Side of a Fastener.

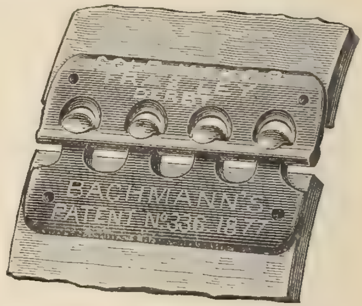


Fig. 20.—Belt with Fastener attached.

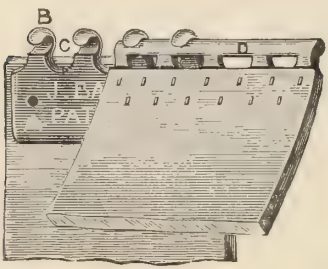


Fig. 21.—Mode of Detaching Belt.

Fig. 22.—Method of attachment of Belt.

described as Bachmann's Patent Detachable Belt-fastener, is intended for light belts, and will be found a great improvement on ordinary fasteners. The following illustrations will convey an idea of the fasteners.

Fig. 19 shows the under side, which, when fixed, adjoins the strap. It will be seen that it has a number of sprigs which are wedge-shaped and partly pointed; they are nearly $\frac{1}{4}$ inch long, and when driven home in the belt effect a secure attachment. Fig. 20 shows a portion of the belt with fastener attached. Fig. 21 illustrates how the belt is detached. The Plate A has hooks, B, 2, 4, or 6, according to size, in which are grooves, C. The bar of Plate D slides into the hooks, B. The Plates

A and D can only be hooked together at the angle shown in the illustration; and as the belts run with the open or grooved side outwards, it is impossible for the belt to become detached until it is taken off the pulley.

Fig. 22 shows the method of attachment to the belt by the sprigs. It will be evident to those who have to do with leather or other belts that this simple fastener is most useful and effective, the process which is often so tedious being now rapidly performed; and as the belt can be taken from its work to any convenient place whilst the attachment is being made, there is much less risk of accident to the operator than when the fastening had to be made whilst the strap was in working position; whereas now the hooking of the two ends together at the place of work is but a momentary operation and comparatively free from danger. The attachment is very simple and easily made. All that is necessary is that the plates should be set on the belt square and true to the edges of the same, and that the edge should be cut away so as to leave the groove C clear. These fasteners run from 1 inch to 6 inches by $\frac{1}{4}$-inch gradations, and are priced from 18*s.* to 78*s.* per gross.

A second fastener for stronger belts, suitable for actuating from 10- to 100-horse power, described as Bachmann's Patent Crocodile's Mouth Belt-fastener, was exhibited. The nature of this contrivance will be readily understood by the following

Figs. 23 and 24.—*Illustrations of Bachmann's Patent Crocodile's Mouth Belt Fastener.*

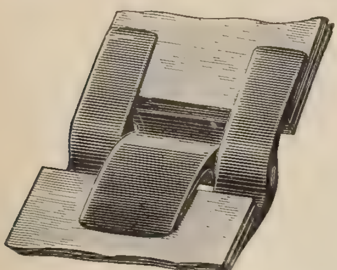


Fig. 23.—Under side of Belt with Fastener fixed.

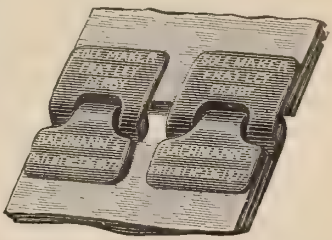


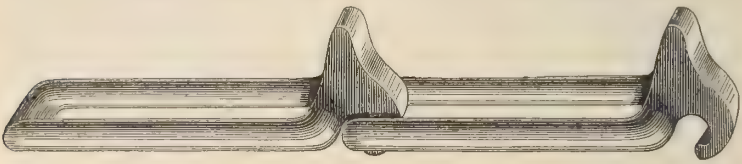
Fig. 24.—Upper side of Belt with Fastener fixed.

illustrations:—Fig. 23 shows the under side of the belt, with fastener fixed; Fig. 24 shows the upper side. The mode of attachment is by sprigs, just as in the detachable fasteners. Sizes range from 3 to 6 inches, and prices from 10*s.* to 20*s.* per dozen. Like all the other exhibits of Francis Ley, the material is malleable cast-iron of excellent temper and quality.

Mr. Ley showed a large collection of Driving Chains of different sizes, with Elevator Buckets and Carriers for various purposes. For raising large quantities of material such machinery is most useful; and at the works, which are well worth a visit, we saw portions of a conductor being made for a London gas company to carry from 30 to 40 tons of coal per hour a considerable distance, effecting a great saving over horse power.

Ewart's Chain requires to work on a sproggle wheel. Quite a novel arrangement, shown for the first time in this country, are Dodge's Patent Detachable Friction Drive-Chains, which work in a grooved wheel by means of tongues or claws, which fit into the groove, affording sufficient hold of the wheel without any loss of power. The following illustration will show the forms of the links:—

Fig. 25.—*Dodge's Patent Detachable Friction Drive Chains*, No. 4926.



This chain works with very little noise or friction, and is available for many purposes. The price ranges from 1*s.* to 10*s.* per foot lineal. Another very strong chain, Dodge's Giant Chain, which is much used for extra heavy work, comprises a series of double and single links. Some idea of this chain may be gathered from Fig. 26, p. 625.

The collection of malleable castings was noticeable for accuracy and finish. The quality of the material was proved by hammering and twisting a link into such a position as would be a serious test for wrought iron. The mouldings are taken from stereotypes, an invention of Mr. Ley's, which secures great accuracy. New uses for these various forms of chain-gear are constantly being found out, and having regard to their durability and comparative cheapness as compared with leather, it is not a matter of surprise to find that Mr. Ley is greatly increasing his producing power.

Messrs. Foster and Co., of the Wellington Foundry, Lincoln, exhibited an engine fitted with *Starkey's Automatic Expansion Slide Valve Gear*, actuated by the governor.

This is an arrangement for shifting the position of the eccentric by means of a train of wheels gearing into each other, independent motion being imparted thereto by any variation of the speed of the engine.

On the eccentric of the expansion slide is attached a geared wheel, this wheel and the eccentric being loose on the crank-

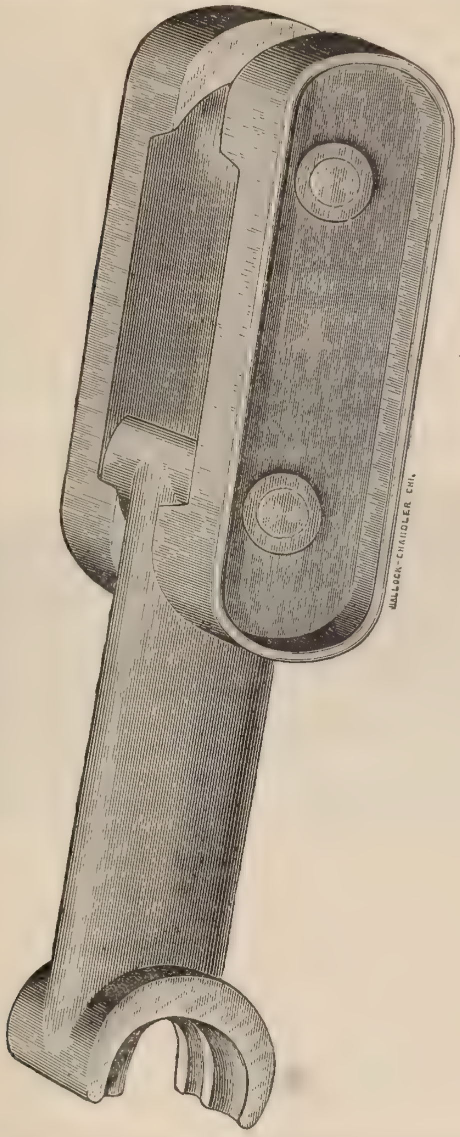


Fig. 26.—*Dodge's Patent Detachable Giant Drive Chain*, No. 4925.

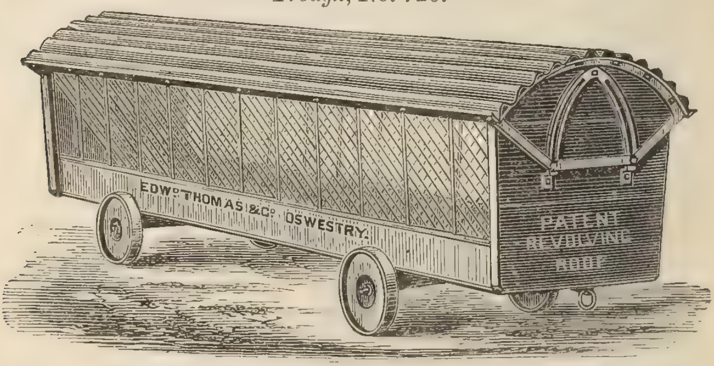
shaft; a second wheel of the same diameter is keyed on to the crank-shaft. On a movable bar in connection with the governor are two geared wheels, one gearing into the outer wheel on the crank-shaft, and imparting motion to the second

wheel, which latter, by means of an intermediate wheel, drives the wheel attached to the eccentric on the crank-shaft.

So long as the governor is working at a uniform speed, motion is imparted to the eccentric in the same direction and with the same speed as to the crank-shaft; any variation in the governor alters the position of the two wheels carried on the bar in connection with the governor, and in so doing retards or increases the motion given to the eccentric, and thus varies the travel of the valve. The apparatus was shown at Derby applied to a portable engine. It is equally applicable to the lift valves usually fitted to beam and other engines of high power. Messrs. Foster have so used it on a large beam-engine which drives the machinery in their works. The inventor claims also the application of this arrangement to reversing gear, and for shortening the stroke of an hydraulic pump as the pressure increases.

Edward Thomas and Co., of Oswestry, are the makers of novelties in the form of Combined Sheep-racks and Troughs,

Fig. 27.—*View of Messrs. Thomas and Co.'s Combined Sheep-rack and Trough*, No. 710.



with revolving corrugated iron roofs, which can be readily opened or closed without risk of accident from the violence of the wind, or unfair treatment by the workmen. A sheltered rack with manger for corn or roots, which can be kept dry from most rains, and can be readily moved about the fields, is a valuable implement, tending towards early maturity, if the proper materials are used for food. At any rate, however valuable and suitable the materials, there will often be much of them wasted if the troughs are open and the food liable to be wetted.

The Sheep-rack is made of the best red deal, with carefully-arranged bars to prevent waste, and troughs sloping to the centre. As will be seen by Fig. 27, it is mounted on four wheels and fitted with the new patent revolving roof. This is made of

one unbroken sheet of galvanised iron, fitted to a strong angle-iron frame, with cranked levers working on two pivots, thus relieving the roof of all strain. The opening should be done by lifting the cover in the centre. In opening, the roof revolves eccentrically, carrying the opening side well up, giving complete access to the interior for arranging and supplying the food. This rack is also fitted with a new and simple arrangement of folding-boards, which are useful when chopped food is given, but which can be folded up when long hay is used. The rack weighs about 3½ cwts., is mounted on cast-iron wheels, and can be moved as required by one man. Price 4*l.* 4*s.*

Fig. 28.—*Messrs. Thomas and Co's Circular Combined Sheep-rack and Trough*, No. 712.

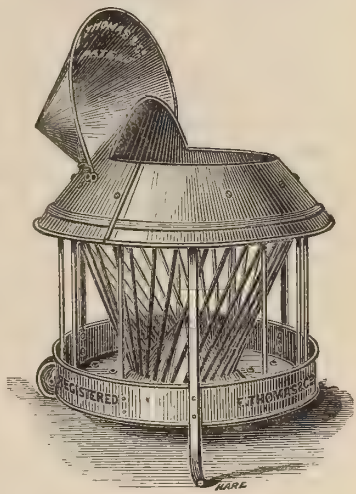


Fig. 28 represents another novelty by the same firm in the form of a Circular Combined Sheep-rack and Trough. It is made of strong galvanised iron, fitted with diagonal bars, extending from an angle-iron frame supporting the roof into a cone in the centre of the trough, which, with the space inside the roof, will accommodate a considerable quantity of fodder. The trough is also spacious, and made for feeding twelve sheep at once, and is fitted with a wheel at the back for convenience in moving. The form of this rack being radial, it affords room for the bodies of the animals when feeding. It is handy and light, but more exposed to the influence of the weather than the long-shaped troughs. The roof arrangement is very simple and ingenious; and when the movable portion of the cap is open, there is plenty of space for introducing fodder. The weight is about 100 lbs., and it is proposed to make these troughs of different sizes. Price 2*l.* 5*s.* For export they can be packed in about one-sixth the space occupied when set up for use.

Although not novel in principle, the Judges approved of the construction, and adaptability to its object, of article No. 275, Patent Bullock Gear for 8 Oxen, shown by the Reading Iron Works, with a third motion for giving 100 revolutions for each revolution of the oxen, intended solely for colonial work. The following description will explain the general features of this well-constructed gear. The whole of the gearing is contained within a cylindrical

casting, 2 feet 6 inches high, and 3 feet 1 inch in diameter. The cap is formed with pockets to receive the poles, and is capable of revolving upon the turned edge of the above-mentioned cylinder. The inner edge of the cylinder is formed at the top into an internal toothed-wheel gearing, into which, and pivoted to the revolving cap, are three idle wheels which also gear into a spur-pinion, keyed to a vertical shaft, the top end of which runs loosely in the cap, whilst the bottom is carried by a footstep. Near the bottom of this vertical shaft is keyed a bevel-wheel, which drives a bevel-pinion fixed to a horizontal countershaft. On this countershaft is keyed a spur-wheel, which gears into a spur-pinion upon the layshaft to which it gives motion. The end of the layshaft projects outside the cylinder and carries a clutch so contrived as to be able to drive in either direction, and also (by means of pawls engaging into notches) to continue revolving after the bullocks have stopped. The layshaft is continued by lengths of shaft coupled by universal joints, so as to be connected with the machinery to be driven.

For one revolution of the cap the vertical spindle revolves six times, the first countershaft 32·4 times, and the layshaft 97·2 times, or altogether nearly 100 to 1. The advantages claimed for this mechanism are—perfect balance of the main gearing, the strain being applied at three points in the circle; great strength, owing to so many teeth being in gear at once; compactness, lightness, durability, and safety. The whole of the gear, being boxed, is kept free from dust and dirt, and there is no risk of accident to the attendants.

A great novelty in Chaff-Cutters was shown by *Messrs. Smith and Grace*, of Thrapston, who, as far as I know, have obtained quite an exceptional mode of action to the feed-rollers, which are intermittent in their motion, resting whilst the knives are cutting, and pushing the hay forwards whilst the knives are out of work, and thus, imitating the intermittent action of the man's hand, pushing forward the hay in the old box and knife. This, and the fact that, by very slight alterations, eight different sizes, ranging from $\frac{1}{8}$ to $1\frac{1}{2}$ inch, can be cut, are points of merit that might have justified a Medal, had the machine been as suitable for power as for manual labour. The intermittent action of the rollers undoubtedly tends to secure a clean uniform cut, with a less outlay of power than when, by a continual action, the hay is forced against the knife, which must result in a more or less ragged cut. Hence it is that, with knives of the best construction and in excellent order, the result of cutting by power is so rough that the chaff is frequently screened, and the long straws passed through again.

On the main shaft, which carries the fly-wheel, there is a disc,

on the face of which is a movable slide which forms the crank, the different lengths of cut being obtained by moving the slide nearer or farther from the centre. From this is attached, through a connecting-rod, a rocking-shaft, which runs across and under the box, and has at either side a pawl or catch working into ratchets, keyed on the bottom roller-shaft. Thus there is a ratchet for each knife, and the necessary intermittent motion to the rollers is obtained. As soon as the knife has cut through the hay, each ratchet moves on the feed. The top roller is geared to the bottom roller in the ordinary way. The chief novelty is in the two ratchets, which have never been applied in the same way before. The machine costs 3*l.* 10*s.*, the fly-wheel is 3 feet 6 inches diameter.

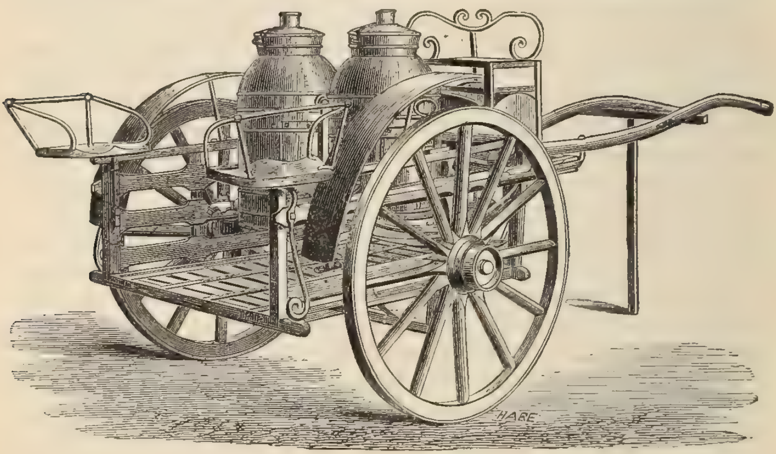
The Judges were very favourably impressed as to the superior merits of the Wire Ropes shown by Messrs. George Cradock and Co., of Wakefield, and made under John Lang's patent. The principal difference between this and the ordinary wire rope is that a larger surface of the wires is exposed to friction. There is, therefore, more to wear away before the rope becomes useless, and from the nature of the twist, when working over pulleys, drums, or round curves, the wires are bent obliquely, and not in the straight line as in the old rope. The contention is that, by the ordinary mode of construction, the wires are worn on the crown of the strands, whereby friction is confined to a very small portion of the wire only. The wires in an ordinary rope are almost in a straight line with the rope, and as they retain their full size and strength on each side of the worn or weakened part, the working of the rope around drums, pulleys, and curves, causes the bending to take place on the worn or weakened part especially. Hence the reason why so many ropes have to be thrown aside as useless, through the breaking of wires when but slightly worn. In proof of this view, a portion of one of Lang's ropes, that had been at work in a colliery for a year, was exhibited, and contrasted with a used-up rope on the old construction, in which some of the strands had worn through, whilst others, not exposed, were as good as new. Lang's rope exhibited a uniformly worn surface, and, judging from appearances, fully bore out all that was said in its favour. The exhibitors state that as yet they have not made many ropes for steam-cultivation, and though those they have made have given satisfaction, there was no opportunity for a trial, without which no award was possible. If it can be proved that this rope is capable of doing an increased amount of work—varying from 2, 2½, to 3 times the efficiency of the old rope—it is a most valuable discovery. All that the Judges can do is to advise those who are steam-cultivators to purchase a rope, and compare

its durability and efficiency for themselves. Another merit of the invention is that, as the wires do not break, a harder, and therefore more durable, wire can be used.

Dairy Implements formed an increasingly important feature of the Show. The Dairy Supply Company and the Aylesbury Dairy Company were the largest exhibitors, the collections on both stands being very complete. Milk railway-cans were shown in various forms by several firms.

Messrs. Vipan and Headley, of Leicester, showed a very well-made and practical Cart on springs, either for delivering milk in a town, or for conveying railway-cans to and from the farm to railway stations, or for carrying live-stock. The character of the cart will be understood by the following drawing (Fig. 29).

Fig. 29.—*Messrs. Vipan and Headley's Spring Milk Cart*, No. 1605.



A cranked axle secures a low body, of great importance in saving labour, and strong springs prevent undue jolting. A removable framework allows of two swinging cans being carried, from which the milk is drawn through taps; a trough underneath prevents waste. The wheels have patent axles. The body is light and strong, of English oak and ash. The following are the particulars of dimensions and weight:—

	Ft.	In.
Length of body	4	9
Width „	3	6
Depth „	1	8
Height of Wheels	4	6

	Cwts.
Weight without cans	6·2·0
„ with 2 „	7·2·0

For filling the delivery-cans the shafts can be raised, thus bringing the cans to the proper level, and avoiding the necessity of lifting them when full. The milk can either be dipped from the can, or drawn away by the tap. A box in front is useful for carrying eggs, butter, &c. Provision is made for locking the cans, so as to minimise the shaking of the contents. Two adjustable seats are provided, and a box for books; also a cover or tilt to keep off the rain. Each of the delivery-cans holds 20 gallons. The price complete, including the arrangements for swinging cans, is 26*l.* The cart alone is 19*l.* 10*s.* For carrying cans to the railway, four cans can be carried easily, and possibly six at a pinch. Beyond its special province, this cart would be useful on a farm for many purposes, carrying small live-stock, cake, corn, &c. &c.

Messrs. Western and Co., of the Chaddesden Works, Derby, exhibited, in connection with one of their circular saws, probably the greatest novelty in the Showyard, viz., a Dynamo-Electric Machine, driven by an eight-horse-power engine, which, by means of a strand of copper wires, insulated with india-rubber, transmitted the electricity to a similar machine, which drove a 36-inch circular saw, the motor being connected to the countershaft of the saw-bench by an ordinary coupling. The batteries, which were supplied by Siemens and Co., cost 70*l.* each, and the wire 4*l.* per 100 yards. There is practically no limit to the distance to which the current can be conveyed—always provided that the first cost of the conductor does not prove too great for the undertaking. The merit claimed, and I think justly claimed, for this novel process of communicating force is, that when the motive-power—a water-wheel or other natural power—is required to operate at a distance, it can be transmitted, without appreciable loss, by a wire readily fixed. For instance, such machinery might be used upon an estate, when water-power was available, to cut up timber, drive agricultural machinery, &c., at points remote from the power.

An effective carriage-lamp is an article of considerable value to the traveller by road, and is also of great use for traction-engines, which must, in many cases, travel by night. The ordinary carriage-lamps have so little reflective power that they only serve to make darkness visible. The remarkable efficacy of *James Westaway's* "*Guidance Lamp*" depends upon the presence of patent hinged wing-reflectors, which are attached to each side of the lamp, and shut close to the glass when not in use, and opened to any required angle when in use. The light is concentrated and reflected to the ground in front of the carriage, each reflector being capable of showing a ray of light superior to that from the lamp itself. It is said that the light from each

lamp is equal to that of three ordinary carriage-lamps. The rays from a pair can be cast in any direction, and spread to such an extent as to meet a few yards ahead. The reflectors being slightly curved, the light takes a downward direction, illuminating the ground in front of the carriage for nearly fifty yards. For dog-carts, one dash-board lamp with reflectors gives ample light. These lamps are manufactured by Insole and Grimley, of 76, Hurst Street, Birmingham, and cost 1*l.* 12*s.* per pair.

The subject of *Compound Engines*, as applied to agricultural, portable, and traction powers, is receiving increased attention. It will be remembered that Messrs. Fowler and Co., at Kilburn, showed a Fixed Engine for Agricultural purposes fitted with compound cylinders. This was followed up at Carlisle by Messrs. Garrett and Sons, who applied their apparatus both to portable and fixed engines. Besides these, at Derby there were shown Compound Traction Engines by Messrs. Aveling and Porter, and by Messrs. Burrell and Sons. It is therefore evident that this important economical improvement is occupying the serious attention of exhibitors, and it is probable that their inventive faculties might be stimulated by the offer on the part of the Society of substantial rewards for success. I am very glad to be able to append to this report a valuable communication from such critics as Messrs. Easton and Anderson (p. 661), the Society's Engineers, which very clearly brings the subject up to date, and shows what are its future possibilities. I cannot close this short and very meagre report, without expressing our cordial appreciation of the unvarying consideration shown the Judges by the Stewards of Implements, to facilitate in every possible way our work; and it would be equally an omission if I failed to express my own personal obligations to the Engineers, and especially to Mr. F. S. Courtney, for the valuable help he was ever ready to afford, and which, as regards points of construction, was most valuable.

XXXIV.—*Report on the "Working Dairy" at the Derby Show.*

By HERBERT J. LITTLE, of Coldham Hall, Wisbech.

MILK and honey were to be among the special blessings of the "Promised Land." It is evident from an ancient Book how much importance in Eastern imagination was attached to an abundance of these essentials of human and animal existence. With the advance of civilisation, honey has had to yield in importance to other forms of *saccharum* extracted from the vegetable world by human instead of insect industry, but none the less has

sugar kept its place in the estimation of the human race, till this and all other industrial nations can boast of the enjoyment of such an abundance of the products which now stand in place of their more ancient prototype, that (so far as the plenty of it is concerned) there would be little exaggeration now-a-days in describing our own country in language as glowing as that which Moses addressed to his Israelitish followers. "The delight of childhood and the solace of old age" has in recent years, indeed, become plentiful to a degree undreamed-of in former times. The luxury of a century or two ago has now become the necessity of every labourer's household; nay, it may be added, of every pauper's child. Indeed, perhaps it would be difficult to name any single product of modern consumption which will compare in cheapness and plentifulness with sugar. An article which, notwithstanding the labour necessary for its manufacture, is sold in its cheaper forms at a price scarcely exceeding that of fine flour, may almost be said to have attained the *ne plus ultra* of abundance.

But the other delight, which preceded the honey in Mosaic promise—where is it?

In this country of ours, which, more accurately than any Canaan, may be described as "a land of hills and valleys, which drinketh water of the rain of heaven,"* or "a land of brooks of water, of fountains and depths that spring out of valleys and hills," † the first luxury of Jewish imagination is, alas! (as far as the majority of its population is concerned) a thing conspicuous by its absence. Milk, in its primitive form the first essential of infant existence, and in its subsequently varied types one of the luxuries of epicurean indulgence, has somehow been banished from the poor man's table, whilst the rich have had to seek abroad those daintier forms of its manufactured delicacies which foreign dairies have forestalled us in producing.

To take the commonest product of the dairy: surely it is little less than a scandal to English agriculture that good wholesome butter of home make should be a rarity instead of an article of easy acquisition and everyday consumption. Yet it is undoubtedly the case, that in comparatively few households of even refined taste can reliance be placed upon this primest requisite of the breakfast-table, whilst all sorts of piquant condiments are devised to cheat the palate and render the rankness of the yellow mixture miscalled "butter" less evident.

As for cheese, the importations from foreign countries are also

* Deut. xi. 11. † Ibid. viii. 7.

now so enormous and increasing, that we may well ask ourselves whether it is not possible, by greater care in its manufacture and more scientific methods of management, to revive the fame our country once enjoyed for a product of such universal consumption. It is a melancholy thing (for a farmer at least) to find himself at each visit to his grocer almost confined in his choice of this article to American wares, rarely of a first class, and often of a very inferior character. Yet I feel sure that I am echoing the universal feeling of consumers in the non-cheese-producing districts when I assert that it almost yearly becomes a more difficult matter to obtain a fairly good English cheese,—whether the Cheshire, Cheddar, or Leicestershire make be preferred. Where are the rich buttery Cheddars of our youth, which, ripened by age, formed a dish fit for the luncheon of a prince? Where the fine fat Stiltons? Alas! these have ignominiously succumbed to Gorgonzola, or degenerated into delusions and snares, retaining indeed the old names, but certainly with no other characteristic in common.

Again, what a field seems open for the enlarged production of milk itself! Out of the four millions of inhabitants in the metropolis, or the hundreds of thousands who swarm the streets of our other great cities, it would be interesting to inquire how many receive a daily sufficient supply of this most nutritious of foods. Skim-milk and butter-milk might advantageously be substituted for many of the drinks of the present day. It is surely probable that the temperance movement of the present day may increase the sale of milk to an almost indefinite extent, as the folly becomes more apparent to the town workman of wasting so large a proportion of his earnings in a hurtful indulgence instead of invigorating his faculties by a wholesome beverage.

In view, therefore, of the increasing importance of dairy management, and the absolute necessity of reform in the manufacture of some important dairy products, I think that our greatest English Society did wisely a few years ago in instituting a "Working Dairy" at its annual exhibitions. In a county like Derby there is a special fitness in such a show. The importance of dairy interests in that county may be judged by the fact, that while the whole of Great Britain only maintains an average stock of one cow or heifer (in-milk or in-calf) to each twenty acres of land, Derbyshire just doubles that proportion, and, according to the latest agricultural returns, possesses one such animal to each ten acres. Yet here, in the heart of a district not only specially adapted for, but also mainly devoted to, dairy management, so great appears to be the apathy with regard to the possession—or perhaps, rather, I should say the

exhibition, of the best animals, that, notwithstanding the *éclat* which such prizes confer, the Dairy Classes at Derby only attracted twelve animals in all; and with nine prizes, varying from 20*l.* to 5*l.* in value, only four entries were made!* Contrast this with a show held in the ancient city of Ghent in Belgium, only the Sunday before the Derby Show, where 280 cows were exhibited, as Mr. Allender, who was present, informs me! It certainly may be hoped that of the number of persons who so eagerly thronged the exhibition, not a few would carry home with them some new conceptions of the importance of points hitherto quiescently neglected or despised; and many lessons would be learned which may have their effect in the improvement of this very important and interesting part of farm and domestic management. It is my duty to describe, as well as I can, the daily routine and management of this feature in the Show; and I trust that, even to some persons who witnessed the various processes, a recapitulation of the proceedings may not be without interest.

In the centre of the Show-ground a large conspicuous edifice, which proclaimed upon its roof its title, testified to visitors the whereabouts of the "Working Dairy." The arrangement and planning of this fabric was entrusted to a small Committee of the Council,† and the Society was most ably seconded in its designs by the Managing Director of the Aylesbury Dairy Company, Mr. G. M. Allender.

A few words may advantageously be devoted here to the construction of this shed, and the arrangement of its machinery, and this description will be elucidated by the Plan which was supplied to visitors, and which is reproduced here, p. 636.

The whole erection, which was included under one roof, was divided in the centre by a ten-horse-power engine, which supplied the motive-power for the machinery, and by the manager's office. The engine was, of course, efficiently separated from the two ends by boarded partitions; and a passage, with a doorway at either end, rendered the two parts of the building separate and distinct. One of these divisions was devoted to cream-separators and an exhibition of cheesemaking from skim-milk on the German system; the other was the "Dairy," properly so called. A row of shafting, extending almost the

---

* It must in justice be mentioned that fear of foot-and-mouth disease, which existed in some parts of the county, no doubt deterred some exhibitors; but there are other reasons for indifference to show. English judges often go in for condition and symmetry associated with beef-making qualities, and entirely neglect real milking points. So long as this exists, owners of good dairy cattle will stand at a disadvantage, compared with exhibitors of highly bred Shorthorns, and other famous breeds.

† This Committee consisted of Lord Vernon, Mr. Jacob Wilson, Mr. Neville, Mr. Allender, and Mr. Jenkins.

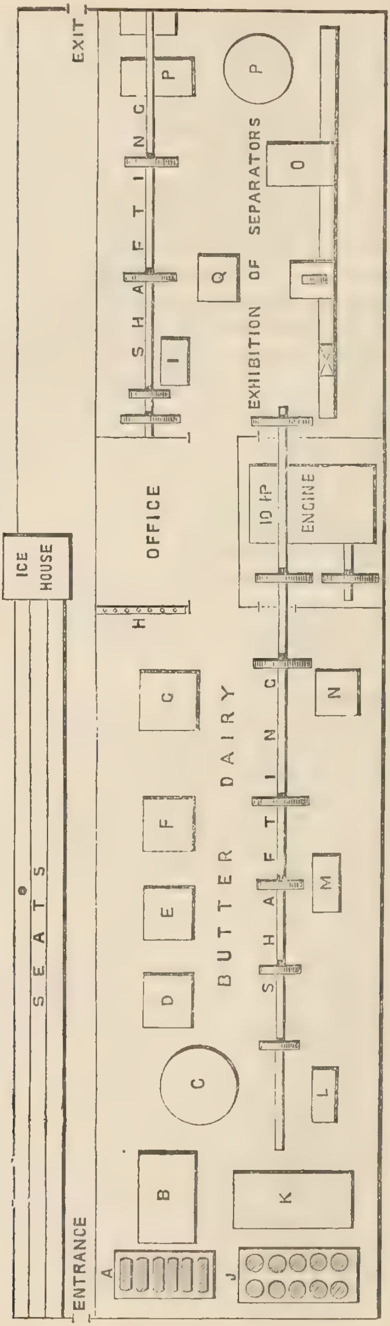


Fig. 1.—Ground Plan of the Working Dairy.

A. Milk set on Danish system.
B. Table for making up and weighing butter.
C. Embree Butter-worker.
D E F. Various Churns.
G. Butter-worker for factory use.

H. Models showing Milk Constituents.
I. Laval Separator.
J. Milk set on American System.
K. MM Butter-worker.
L. Lawrence's Refrigerator.

M. American Swing Churn.
N. Machine for Weighing Milk.
O. Danish Separator.
P. Vessel for Cheese-making.
Q. Lefeldt Separator.

whole length of the building, carried the pulleys and belting for the numerous churns, &c., in the dairy division of the shed, and for the cream-separators in their own department. These latter were arranged upon a strong boarded floor, whilst the dairy division was paved with red tiles, properly laid, to ensure efficient drainage. Notwithstanding the interest of the separating machines, the Dairy department was probably the most attractive upon the whole. At the engine end a galvanised tank gave a constant supply of hot water for the cleansing of vessels, and a tap connected with the main gave a supply of cold water. At the other end of the dairy were two brick-built and cemented tanks, in which the milk, set upon the American and Danish systems, was placed each day, and from which a considerable portion of the cream used for churning was obtained. In the intermediate space the various churns and butter machinery, which I shall hereafter describe, were arranged and shown in frequent work.

On one side a raised gallery extended the length of the dairy and gave accommodation to a considerable number of spectators, who paid for admission. On the other side, the shed was open, and a wide projecting eave gave shelter—fortunately not needed except from the sun's rays—to numerous sightseers, whose curiosity or the state of whose pockets did not tempt them to the payment of extra fees for admission to the gallery.

Such was the general arrangement of the dairy. When it is remembered that bright sunshine and a very high temperature were the normal accompaniments of the Derby Show, it will not be thought remarkable if the well-sluiced floor, the sight of large blocks of transparent ice, and the light and cleanly costumes of the attendants, attracted a constant stream of visitors, who here found, at least in semblance, that refreshing coolness which they in vain sought for in other parts of the Show-ground.

The following was the arrangement of work, according to the official programme for each day of the Show :—

10.0 to 11.30 A.M.—Butter-making from whole milk.
12 Noon to 1 P.M.—Butter-making from cream raised on American system.
2 to 2.30 P.M.—Butter-making from cream raised on the Danish and Swedish system.
3 to 4 P.M.—Butter-making from sweet cream obtained from the separators.

Each process of churning will be followed by an exhibition of butter-working and packing for market.

Cream Separators will work from 11 to 12, and from 3 to 4 o'clock.
The various operations will be explained by a Demonstrator.
Dr. Voelcker will deliver a short Lecture at 2.30 P.M. every day on the Principles of Butter-making.

—and this programme was carried out as nearly as was possible. In some cases the visits of illustrious personages, or other circumstances, necessitated a slight deviation from the official arrangements, but, upon the whole, the plan was adhered to with sufficient exactness. It must be confessed that the interesting lectures delivered by Dr. Voelcker on each day were much marred by the noise of the machinery, which, unfortunately, on two days was kept at work; but this was the only drawback I discovered to this interesting exhibition. It would certainly be well in the future, when lectures are given by a man so well qualified as the learned Doctor to enlighten an audience, that arrangements should be made for the cessation of all work at the period of their delivery.

Cream-Separating Machinery.

The separators used in this section were—

(1) The Laval (Swedish).
(2) The Lefeldt (German).
(3) The Neilson Petersen (Danish).

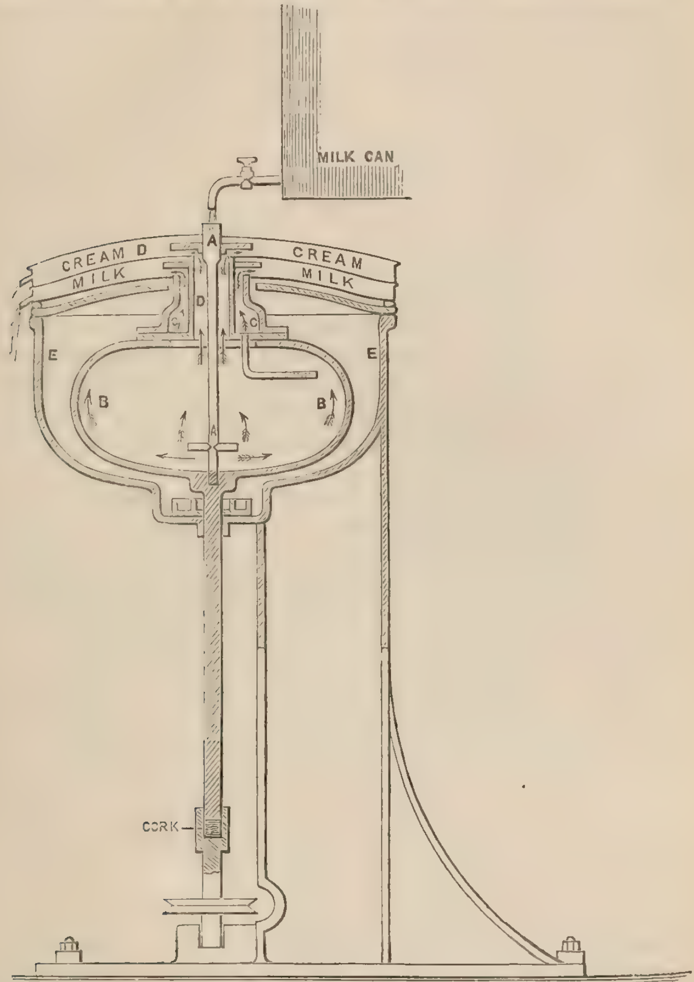
It was by a fluke that the latter most interesting machine found its way to the Show, where it formed the only specimen of its kind in England, though several are at work in Denmark. In Mr. Jenkins's recent travels in the latter country on the business of the Duke of Richmond's Commission, he found the machine in question, and, being impressed with its apparent value, he hastened to acquaint Mr. Allender of its existence. The latter gentleman, by prompt action and the use of the telegraph, succeeded in procuring the specimen in question for the Derby Show: but it was not until the last moment that it was known that it would be possible to include it in the exhibits of which it formed so interesting a feature.

The Laval Separator is pretty widely known since its exhibition at Kilburn in 1879. It obtained a silver medal at that Show, and many other prizes have at various times been awarded to it. The following description by Mr. Coleman and Mr. Courtney, which appeared in the 'Journal' of the Society (vol. xv. part ii. p. 704), together with the illustration which accompanied it, may, perhaps, suitably find a place here, since they give, in words better than I could find, an account of the operation of the machine:—

"Separation in all cases is the result of gravitation. The cream-globules, being of less density than the watery parts, rise to the surface. The action of the machine is to expedite the process, by submitting the milk to rapid centrifugal motion, which causes the heavier ingredients to be thrown to the outside

of the circle, whilst the cream occupies a more central position close round the axis of rotation.

Fig. 2.—*Section of M. de Laval's Centrifugal Cream-Separator.**



A. Hollow tube for receiving Milk.
B. Interior of Centrifuge.
C. Open space whence Milk is delivered to outlet.
D. Delivery for Cream.
E. Cast-iron outer casing.

"The milk, as it comes from the cow, is placed in a milk-can and delivered by means of an ordinary tap into the top of a hollow

* This is a section of the separator exhibited; but the Laval separators now made differ from it in many important respects, and are said to be much more effective.—H. M. J.

tube (a), which terminates in a T-outlet near the bottom of a spherical vessel of about 10 inches in diameter, which, encased in a cast-iron casing (e), rotates at a very high velocity, viz. 6000 or 7000 revolutions per minute. An instantaneous separation takes place. The heavier portion, which represents what we call skim-milk, is thrown to the outside of the vessel, and forced up a bent perforated pipe which communicates with the open space (c), whence the milk is delivered into the middle of two block-tin trays or covers, which are provided with an outlet-pipe. The rapidity with which the milk enters the centrifuge must be regulated according to the velocity with which it is driven; the greater the speed the more rapid the separation. The cream remains near the centre, rises round the outside of the inlet-pipe, and delivers itself into the upper tin tray (d), where it is discharged through an outlet-pipe. The rotating vessel and shaft are of forged steel, in one piece, tested by a pressure of 250 atmospheres. The shaft rests upon a cork pad (a wooden cup is now used) inserted in the driving-spindle. In the event of the power being cut off by the breaking of the strap, or any other cause, the vessel will continue to rotate for a considerable time."

It is generally thought that, as far as separation goes, this Laval machine, described above, is about perfect. In an experiment in 1879, the skim-milk from the machine was tested without a trace of butter being obtained, and several experiments mentioned in a note to Mr. Coleman's report (p. 707) serve to show that Laval's process will give a superior result on the average to the "ice method." Yet it has certain disadvantages which do not render it a favourite with some who have been in the habit of using it. The enormous speed required is one of these drawbacks. A rate of 5000 to 6000 revolutions per minute, which is now said to be requisite (instead of 6000 to 7000 quoted by Mr. Courtney) is still a prodigious speed, and an accident to any part of the machine might lead to very unpleasant consequences. Moreover, it will only separate about 30 gallons of milk an hour.

The principal objection to the improved Lefeldt machine is perhaps its heavy and cumbersome make. The thickness of cream can be regulated by opening or closing valves within the machine; but for this purpose the very heavy cast-iron top must be lifted off by pulleys. Another objection is that if the belt slackens, the machine must be stopped, as no alteration can be made while it is in motion. The number of revolutions required by the Lefeldt is 2400 per minute, and the separation is exceedingly good. The action is of course centrifugal, and, so far, on the same principle as Laval's (of which, indeed, in its original form it was the forerunner), but it is very different in diameter

and appearance, and though it is said to be capable of separating 100 gallons of milk an hour, it requires more power and is three times as costly.

The top of the Lefeldt being lifted off, it displays a domed kind of inner case, with a central hole through which the milk is conveyed to the bottom of the centrifuge. The cream is thrown over this dome top, between it and the outward case, and passes by a deep groove all round through the spout by which it escapes.

The difficulty of working this machine was illustrated in one of its runs, 5.20 P.M. on Wednesday. After a few minutes it was found that the cream-spout was blocked. After the machine had been brought to a stand and the top removed, the internal cylinder or feeder had to be taken out before the tube could be examined. In justice to this machine, it must be observed that the work it made seemed admirable.

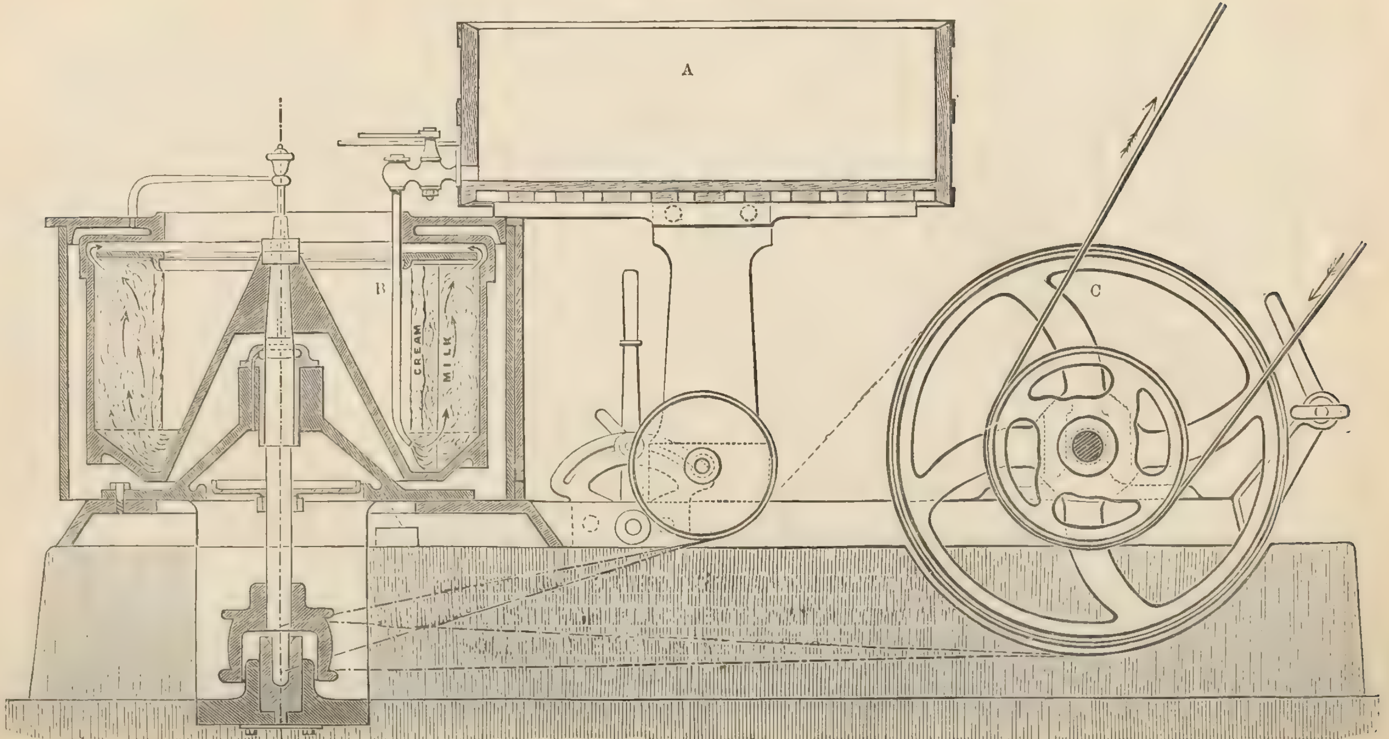
I now come to the chief novelty in this department, the new Danish Separator, to which I have before alluded. This instrument is very different in appearance from its companions, the Laval and the Lefeldt. The same principle is adopted, but the revolving cylinder is open at the top, and consequently the actual process of separation can be observed. The milk is put into a wooden barrel-made vessel, elevated above the separator, from which it flows by an easily regulated tap into the revolving vessel. It is immediately thrown by the centrifugal action of the revolver into a vertical wall round the sides of the cylinder; and two brass tubes, sliding in slots on the upper rim of the outer case of the machine, and easily regulated to *tap*, so to speak, one the external body of milk and the other the internal wall of cream, convey the separated products to their respective receptacles, the same centrifugal action which separates the milk and cream forcing them through the small orifices of their respective tubes.

The action of the machine, as well as its general appearance, will best be explained by the accompanying illustrations.

"The diameter of the drum inside is $25\frac{1}{2}$ inches, so that the internal circumference will be about $6\frac{1}{2}$ feet; and as the number of revolutions are 1500 a minute, $6\frac{1}{2} \times 1500 = 9750$ as the surface speed, the measure of the centrifugal force required by the Danish separator to separate the cream from the milk, which is 5250 feet less than the Laval machine."* The advantages of this instrument over its rivals certainly seem to be great. In addition to its open action so that the whole of its operation is manifest, and its moderate speed, which I have before mentioned,

* 'Derby Mercury,' July 20.

Fig. 3.—*Section of the Neilson-Petersen (Danish) Separator and Gearing.*

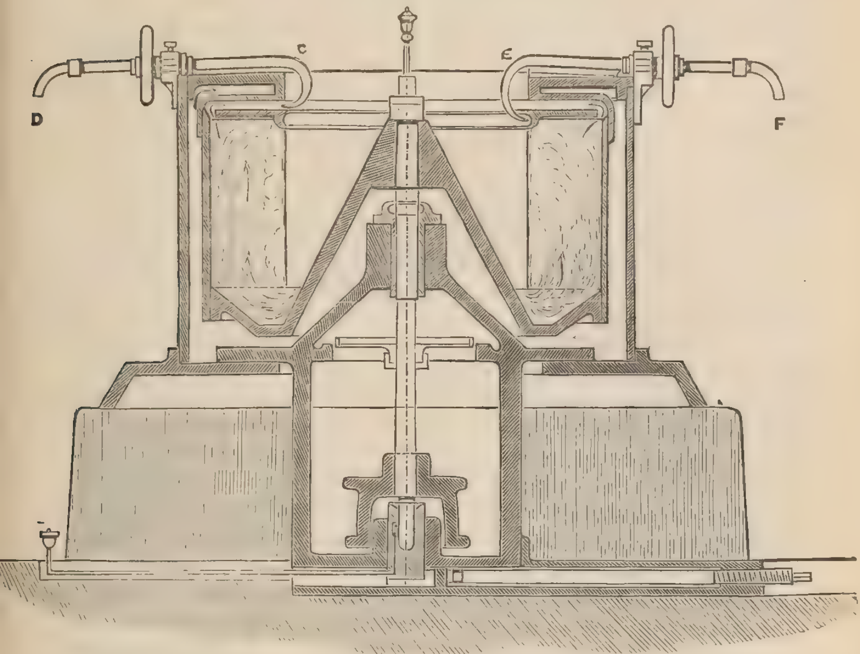


A. Milk Vat. | B. Tube for delivery of Milk into Separator. | C. Driving-wheel.

it is said to be capable of separating 65 gallons an hour, or twice the quantity of the Laval.

It was interesting to watch the machine at work, and to observe the revolving wall of deep-coloured cream backed up by the light blue of the separated milk. The latter is thrown over

Fig. 4.—*Section of the Neilson-Petersen Separator, showing the outlets for the Cream and Skim-milk.*



C. Delivery-duct for Milk.
D. Outlet-pipe for Milk.

E. Delivery-duct for Cream.
F. Outlet-pipe for Cream.

a rim of metal, which, so to speak, confines the rotating column of liquid in its place at the top, except at the back, where the milk flows over the rim and is tapped by the escape tube.

The comparative prices and rates of speed required for the different machines are thus given by Mr. Allender:—

	Price.	Revolutions.
	£	
Laval	33	5000
Lefeldt	90	2400
Danish	80	1500

It was intended that a comprehensive trial should take place at the Show to test the merits of the various machines; but Mr. Allender, not unnaturally, urged the objection to the Stewards of Implements, that such a trial would be incomplete and unfair in the case of the Danish one, which was new to this country of which the working was very little known, and the proper fixings had scarcely been arranged. Moreover, the foundation of the shed was not solid enough to enable any of the separators to be worked practically as they would be in a properly constructed dairy. Under the circumstances such a trial would be inconclusive, as far as practical results were concerned; and this view being concurred in by the Stewards, the trial was abandoned for the time, and it is hoped that it may be undertaken by the Society in London at some future time, and under the auspices of the Society's Engineer and Chemist, as well as the representatives of the makers.

Before leaving this department, I must briefly allude to the cheese-making operation which was carried out here on each day of the Show, and which generally drew a highly interested group of observers.

The method adopted was the making of skim-milk cheese upon the German system, and it was conducted by a proficient from Germany. The milk, from which the cream had been removed, was placed in a copper vessel containing about 20 gallons. This vessel had a steam tap communicating with it for heating purposes, and the milk was immediately raised to a temperature of 32° Réaumur, equalling 104° Fahrenheit. When stirred and evenly heated to this temperature, a gramme of anatto and 10 grammes of rennet are added to each 100 litres of milk; that is to say, for each 22 gallons. (This is about three-eighths of an ounce of rennet and 15½ grains English of anatto.) The vessel is now covered with a wooden lid, and, the heat not being artificially upheld, a slight cooling takes place. In about 25 minutes or so the curd has formed. A cloth is now hung over the pan, and as much of the whey as is practicable is removed by a large white wooden scoop. The temperature is now raised to 100°, and the curd is cut and stirred with a wire divider till every particle of it is disintegrated. This process lasts some 30 to 45 minutes, and its temperature is continually tested during the time by a thermometer immersed in it, and its condition also by the hand of the operator. The time of stirring is regulated to some extent by the feeling of the curd in the hand. When the oily feeling has abated and a *dry* feeling succeeds, it is fit for removal to the mould. The process is simple. A piece of elastic hoop-iron is wrapped in the outer edge of the cloth intended for use, and the iron, being taken in the hands at each end, is easily bent

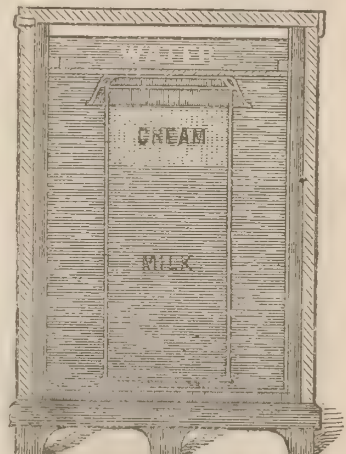
so as to pass it with the canvas under the entire mass of curd and whey, the iron exactly following the circular curve of the pan. As the cloth is drawn up, the whey is squeezed out and drained off by hand, and the curd resembles a gigantic pudding enveloped in its meshes. It is immediately placed in the mould, which is circular, and like a moderate-sized Leicester cheese in form. This, being of elastic wood, is easily enlarged or contracted by certain ties or bands attached outside, and experience will soon show the size required for the quantity of curd. It is now immediately put in the press, and a rough lever with a weight quickly squeezes out the superfluous whey, which drains away by a channel provided for it.

I have now described all the operations conducted in this division of the building, and must turn to the WORKING DAIRY itself.

In my account of this department I will first deal with the methods of setting milk adopted, and afterwards with the churning and butter-making implements exhibited. I have before mentioned that the Cooley (American) and Swartz (Swedish) systems were represented here, a brick tank being devoted to each method.

In the Cooley plan the cans containing the milk are entirely submerged. The vessels are mostly circular in form, though, of course, this is not necessary. Some are of an improved shape, invented by the Aylesbury Company. These have a central hollow cylinder passing through their middle, open at the bottom, and communicating with their sides just under the lid by hollow perforations. By this plan the surface of cans exposed to the water, in which they are plunged, is increased fully 10 per cent., and their efficiency much increased. The covers of these cans do not fit down closely. Such a plan would be injurious to the milk immersed. It is claimed for this system that the animal odours and gases are more effectually disposed of by this process than any other. The covers are raised about half an inch from the top of the cans, and are prevented from closing by cleats fastened inside, thus securing

Fig. 5.—*Cooley System.*



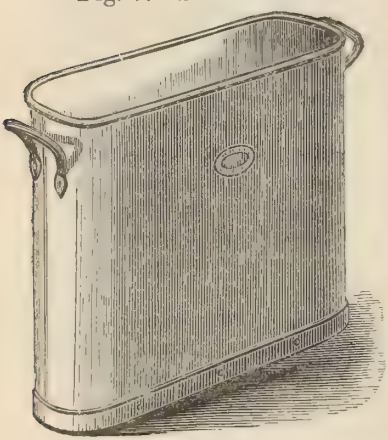
a free circulation from the milk into the water through the air confined under the cover. At the same time the water most effectually seals the milk from any contact with the atmosphere; and as the milk when placed in the cans is at a temperature of

Fig. 6.—*Cooley Creamer.*

80° or 90°, and the water 45° to 55°, the natural effect is for the odours and gases of the milk to rush into the water, and be immediately absorbed by it.

The Swartz cans, like the Cooley, are deep set, but, unlike them, are not entirely submerged, and therefore require no lids. They (at least such as were exhibited at Derby) are also different in shape, being ovals, about 2 feet long, 20 inches deep, and 6 inches wide. Their size and shape render them particularly adapted for dairies where room is limited, as each can contains 10 gallons, and a moderate-sized cistern will hold 8 to 12 of such cans. The method of setting was illustrated in vol. xv., part 1, of this 'Journal,' and the cut is reproduced here.

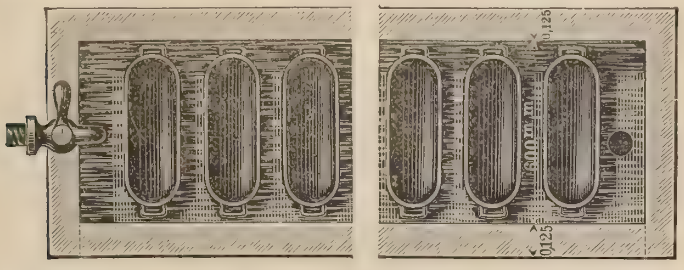
Fig. 7.—*Swartz Can.*



The advantages of this deep-setting of milk are obvious. If

there is one thing more certain than another in the present day about dairy management, it is the importance of the immediate reduction of the temperature of the milk when first it comes from the cow. Leaving the animal at a temperature of 90°, it

Fig. 8.—*Trough with deep Cans for Setting Milk on the Swartz System.*



can be reduced by this method in a very short time to 50° or 60°; and in hot weather, when the water is acted upon doubly by the extracted heat of the milk and also by the external atmosphere, a few lumps of ice put in the cistern at intervals will keep the temperature of the water at any required level. It should probably never rise beyond 65°, nor sink below 40°. The germs, or organisms, which in warm weather "turn" the milk so frequently in old-fashioned dairies with shallow settings, are thus prevented from forming, and this most fertile source of bad cream and butter is effectually checked. There is also another reason in favour of the system. Milk set in shallow vessels is peculiarly apt to absorb bad gases or smells, and such odours are not always absent from country farms and dwellings. An instance was related to me a short time since of a farm-house in Devonshire, of which it became necessary to tar a portion to keep the wet out of the wall, and, the dairy window being left open, the butter that week acquired a taste of concentrated tar, which rendered it entirely unfit for food. It is certain that much butter is constantly reduced in price by the advent of certain smells into the dairy; and servants are too apt in hot weather to place eatables in the dairy, as the coolest place in the house, in which case, with shallow pans, it is hopeless to expect to secure first-rate butter.

These difficulties are entirely overcome by the submerged system of the Americans, and very much lessened by the narrowed surface of the cream exposed on the Scandinavian plan.*

* In practice, Swartz cans are very frequently fitted with lids, and are kept covered after the animal heat has been driven off.—H. M. J.

The cream set on the Swartz or Cooley system should rise in 12 hours, if the water is at a sufficiently low temperature, and about 20 per cent. of the whole bulk of the milk is usually obtained in the form of pure cream. Before alluding to the churning processes, I wish to advert to an experiment showing how long, even in exceptionally hot weather, milk may be safely kept on the deep-setting system. This experiment was carried out by Mr. Arthur Carey, the "Demonstrator" at the Dairy.

On Friday afternoon, the 15th, some of the milk just brought in from the neighbourhood was placed in an American—Aylesbury Dairy Company's improved—can, with lid, and submerged. On Saturday, at 2 P.M., it was taken out, partly skimmed, and then replaced. It remained the whole of Sunday in the cistern, and on Monday, the 18th, at 10 A.M., was taken out, after having been submerged 61 hours, and found by Mr. Carey, Mr. Robert Neville, myself, and others, to be perfectly sweet. The temperature in the Dairy on Monday was 80°, yet this can of milk stood in the Dairy all day (at least till 4 P.M.), was tasted by numerous persons, and still remained perfectly sweet at the end of 67 hours after its introduction. This experiment shows, I think conclusively, of what value the new system is for the preservation of milk in a wholesome and uncorrupted state even in exceptionally unfavourable weather.

Even in such a small matter as skimming milk (the next process in order), something new may be learned. As the oblong Swartz cans require from their shape a peculiar skimmer, so the deep-setting system has introduced a novel form of instrument which was highly recommended by Dr. Voelcker in his lectures in the Dairy. This skimmer is angular at bottom, and can thus be easily introduced into a can of milk without disturbing its contents. When gradually lowered, and the rim reaches the surface, the cream naturally flows into the vessel till it is full, and as little disturbance is caused by its withdrawal as by its insertion.

The following is a list of the butter-making and working machinery shown in the Dairy:—

1. Large Eccentric Churn, for whole milk or factory use.
2. Taylor's Eccentric (small size).
3. Midfeather Churn.
4. American Swing Churn.
5. Hathaway's Little Model Barrel Churn.
6. Embrée Butter-worker.
7. M M Butter-worker.
8. Butter-worker for factory use.

And besides these, all of which were witnessed in operation

each day of the Show, there were also exhibited Mr. Allender's machine for weighing milk, Lawrence's well-known Cooler or Refrigerator, and some ingenious and interesting models showing the relative constituents of milk, designed by Dr. P. Vieth, the Aylesbury Dairy Company's resident Analyst.

To turn for a moment to these latter. They were vertical columns of a considerable size, perfectly square in shape, and coloured to show the proportions of cream, butter, and butter-milk, skim-milk, cheese, and whey, &c., in a given quantity of whole milk. The milk column in cubic contents equalled exactly 10 gallons of milk, and was therefore 6 feet $2\frac{1}{2}$ inches in height, and about 6 inches square. This column exhibited 15 inches coloured, to show the proportion of cream (when taken by the Swartz system), or about 20 per cent. This cream brings away $2\frac{1}{2}$ inches, representing $16\frac{1}{2}$ per cent., of butter; also $8\frac{1}{4}$ per cent. of albumen, casein, milk-sugar, and salts combined. The skim-milk column has now left 90 per cent. of whey and 10 per cent. of cheese. A column showing the whey contains $3\frac{1}{2}$ out of 54 inches of albumen, casein, milk-sugar, and salts, equal to about 6 per cent. of these constituents combined. The cheese column shows $2\frac{1}{4}$ out of 6 inches of the same constituents, equal to $37\frac{1}{2}$ per cent.; $\frac{1}{4}$ inch or $7\frac{1}{2}$ per cent. of the cheese is fatty matter, and the remaining 55 per cent. water. In these columns a good deal of information was thrust upon ordinary understandings by visible tokens very plain to the unlearned, and I have therefore thought it worth while to describe them. Blue colouring represented water; yellow, fat; brown, casein and albumen; red, sugar of milk; and white, salts.

The various churns were exhibited from time to time during the Show.

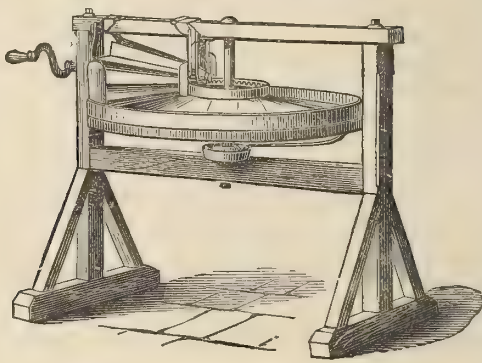
It may, also, perhaps be as well to note with care the exact process employed in taking from the churn, and working such delicate butter as was the whole which was made in the Dairy. The butter-milk (far more resembling sweet- than butter-milk in flavour, as no portion of cream had been allowed to turn sour) was of course strained through a cloth as it ran from the churn, in order to retain every particle or granule of butter. A couple of handfuls of salt were then mixed with iced-water, and the brine being put in the churn, the butter was washed in it; then a washing in plain cold water followed. A second washing with brine, rather stronger than the first, then took place—I need scarcely say that the brine should be strained through a cloth to avoid lumps of salt mingling with the butter—and after a few turns with the churn without water, the butter was fit for removal. It was immediately taken out with wooden

scoops, care being taken not to allow the hands to come in contact with it, and placed on the butter-worker, which I now proceed to describe.

The butter-workers shown at Derby were the "Embrée," an American machine, and the "M M."

The Embrée butter-worker consists of a revolving circular table, sloping from the centre to the circumference, on which the butter is placed and pressed by a fluted roller actuated by hand. The expressed moisture passes by gravitation to a channel round the edge of the table and runs away by an opening provided for the purpose. The attendant keeps moving the butter with a couple of wooden "hands," or beaters, to the roller, which in a short time squeezes out all butter-milk and consolidates it till it is fit to make up. After it is taken from the workers it is consolidated into a large lump and weighed. It is then immediately made up into half-pound

Fig. 10.—*The Embrée Butter-worker.*



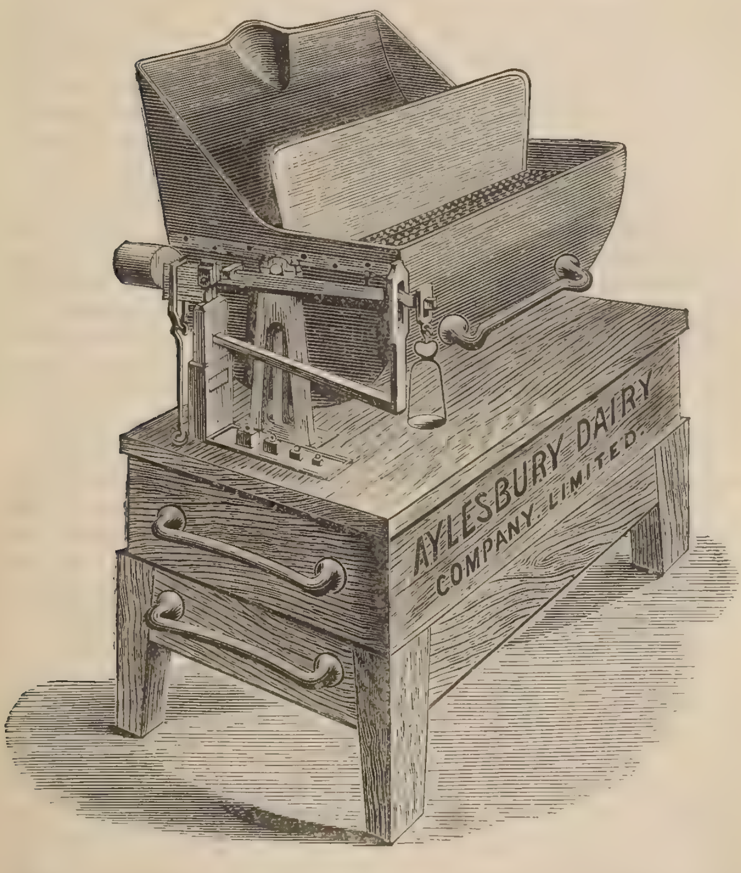
pats, or 1 lb. or 2 lb. lumps, as desired. Half a pound having been taken from the lump and carefully weighed, is placed on a round mould, which is pressed upon it once or twice to give it its ornamental stamp, and the edges are dexterously turned on the fluted edge of the board to give a finish to the whole. Being then placed in a small round basket, enveloped in muslin, it has a very dainty aspect, and a large quantity made at the Show was bought by visitors and carried away by them direct from the Dairy.

The "M M" butter-worker is a hand-machine working on a similar principle, and intended for smaller dairies. Though exhibited at Derby, it was not used there, I believe; but it is obvious to me that machines of this kind are destined to supersede the old barbarous methods of hand-working in all dairies where the finest class of butter is desired.

A butter-worker for factory use was also exhibited. This is a large, open, circular wooden tub, with revolving bent wooden arms inside, which thoroughly work and mix the butter. It will work 1 cwt. of butter in a quarter of an hour, and is principally useful for large dealers in taking the salt out of firkin butter, or mixing thoroughly the butter from several dairies. Mr. Allender informed me that he had taken 10 lbs. of salt out of a firkin of Irish butter with this machine.

I must not omit some mention of a Milk-weighing Machine

Fig. 11.—*Mr. Allender's Milk-weighing Machine.*



which was exhibited and much used during the Show. It was thus described by Mr. Neville last year when shown at Carlisle: "In buying large quantities of milk, it is practically found impossible to get accurate results by measuring, so a machine

has been invented by Mr. Allender for weighing it, by which means the quantity to an ounce is quickly and surely known. It consists of a weighing table about 3 feet 6 inches square; on this are two A frames, between which is supported on trunnions a copper tank holding 35 gallons, or about 3 cwt. of milk. In one half of this is fitted a wire strainer, 80 meshes to the inch, through which the milk is poured. The tank being full, the contents are weighed, a catch is released, and the whole tipped into a tank on the floor, from whence it is used as required."

Lawrence's Refrigerator or Cooler, which completes the list of implements shown in the Dairy, is so well known that I need do no more than allude to it. It was fully described by Mr. Gilbert Murray in his report of dairy implements at Bristol—R. A. S. 'Journal,' vol. xv., part i., page 154. For ordinary farms it may be doubted whether this implement can be excelled. With a good supply of cold water it will rapidly (indeed immediately) bring down the temperature of milk or other liquids from 30 to 40 degrees, and for those who desire to send away their milk, equally with those who wish for good cream and butter, some such process as this has again and again been shown to be indispensable. The smallest machine will cool 80 gallons an hour, and the largest as much as 250 gallons.

Not the least interesting part of the Dairy Exhibition were the lectures delivered by Dr. Voelcker on each day of the Show. The gallery was generally crowded before his lectures began, and much applause accompanied or followed their delivery. The lectures were generally confined to the principles of butter-making, though occasionally the subject of cheese-making was introduced. "How," asked the Doctor in the first of his lectures, "is it that such immense quantities of butter are imported into this country from Holstein, Denmark, France, and even America, when we have such facilities for producing good butter at home? The answer is simple, and it is this—Foreigners make better butter than ourselves,"—and each day some part of his lecture was devoted to an exhortation on the importance of cleanliness, of method in testing the temperature of cream and milk; of the necessity of at once cooling the milk when it comes from the cow; of testing the cream with the thermometer before churning; of preventing the access of bad odours to the milk when set; of carefully providing proper food for the cows; and finally, of avoiding contact with the hands of the dairymaid from first to last. The Doctor expressed his opinion as to the uselessness of attempting to get first-class butter from whole milk, because with whole milk it is impossible to separate entirely the fatty matter and the

casein or curd matter, and it is entirely the curd matter in butter which causes difficulty, and in fact produces a cheesy taste. The best cream, he thought, was obtained from pastures having a good mixture of herbs, and by no means from the richest lands.

Dr. Voelcker more than once in these lectures expressed himself strongly against the use of sour cream for butter-making. In this particular, it is right to say, he is at variance with many experienced persons. Mr. Allender, while admitting that under all circumstances the milk must be sweet, advocates the use of slightly sour, or, as he calls it, "ripened" cream for butter which is intended to be kept. I may also note another difference in opinion between the learned Doctor and Mr. Allender. Cream, according to the former, should be 55° to 57° when put in the churn. Mr. Allender, with great experience, asserts a higher temperature as best, viz. from 58° to 62°, 60° being preferred.

I only quote these little differences as showing how authorities may differ on minor details, and proceed with some other points of these lectures.

The importance of the milker of cows always having perfectly clean hands was dwelt upon. No amount of after-cleanliness in the dairy can remedy this error, when the milk with all its organisms has been thus polluted at its source. Next he alluded to the care with which the cows should be stripped; and he mentioned 55° as a proper temperature for the milk to be immediately reduced to.

He expressed himself an advocate for deep pans in preference to shallow ones, for the reasons previously given by me, and made some remarks on churning leisurely and deliberately, instead of always appearing in a bustle. Steady turning at 45 or 50 revolutions a minute was best. Too frequent washing of the butter in the churn was apt to deteriorate its high quality. 55° to 57° was mentioned as a proper temperature for cream to be kept at till it was churned; and the Doctor recommended one-sixth of pure cold water to be added to each vessel of milk after the first skimming, in cases where it was saved a further 12 hours for another skimming. He laid some stress on the importance of a dry dairy floor, of simple and easily cleaned utensils, of brining or salting in the churn, and of watching the temperature.

There can be no doubt that if these directions and injunctions were generally followed, English farmers and their wives would be more able to compete with foreign competition; and it is sincerely to be hoped that among the visitors to the Derby Dairy, the seeds will be sown of improvement in practice, which will eventually render us less dependent on the foreigner

for articles of daily consumption, of which it should shame us to be beaten in the production.

In conclusion I must express my indebtedness to Mr. Allender and Mr. Arthur Carey, the former of whom so successfully managed, and the latter of whom explained to the visitors the Dairy operations, for much information most kindly given, and without whose co-operation I should scarcely have undertaken this report.

XXXV.—*Further Experiments on the Comparative Value of Linseed-cake, and a Mixture of Decorticated Cotton-cake and Maize-meal, for fattening Bullocks.* By Dr. AUGUSTUS VOELCKER, F.R.S., Consulting Chemist to the Royal Agricultural Society.

IN the months of November–December, 1878, and January 1879, I made some experiments on the comparative value of linseed-cake, and of a mixture of decorticated cotton-cake and maize-meal for fattening bullocks, the results of which were published in vol. xvi. part i. of this 'Journal.'

In these experiments, at a saving of 2*l.* 10*s.* 4*d.* in the cost of the purchased food, the mixture of maize-meal and decorticated cotton-cake produced as much increase in the weight of the bullocks as linseed-cake.

Agricultural experiments, more especially when relating to the feeding or fattening of stock, or the production of milk, in order to be of value, should be repeated in a more or less modified way for a number of years. It appeared to me, therefore, desirable to take advantage of the bullocks which made the dung for the experimental permanent corn and mangold crops in 1880 and 1881, to experiment further on the value of linseed-cake, as compared with a mixture of maize-meal and decorticated cotton-cake, for fattening bullocks.

FATTENING EXPERIMENTS IN 1880 AT CRAWLEY MILL FARM, WOBURN.

Eight bullocks, which had previously produced the requisite quantity of dung for the experimental mangold crop, were divided into two lots; but as one of them, a Hereford, was so wild and unmanageable that he could only be weighed with the greatest difficulty, he was excluded from the fattening experiment, and instead of 4 bullocks in each lot, only 3 were put up in the feeding-boxes.

When the 6 bullocks were put into the feeding-boxes on the 14th of January, 1880, they weighed :—

	Cwts.	qrs.	lbs.		Cwts.	qrs.	lbs.
No. 1.	9	2	2	No. 4.	9	0	16
„ 2.	9	3	15	„ 5.	9	3	25
„ 3.	9	3	2	„ 6.	9	0	12
Total weight of Lot 1 ..	29	0	19	Total weight of Lot 2 ..	28	0	25

Both lots were fed upon the same quantity of sliced mangolds hay, and straw-chaff. In addition, the 3 bullocks in lot 1 received decorticated cotton-cake and maize-meal, and the bullocks in lot 2, linseed-cake.

The bullocks were weighed again on the 16th of March, and removed from the boxes, as they were then in a good condition for the butcher.

In the 9 weeks during which the bullocks were under experiment, the 3 bullocks in lot 1 consumed :—

	Cwts.	qrs.	lbs.
Hay-chaff	9	0	0
Wheat-chaff	4	2	14
Mangolds, sliced	33	3	0
Decorticated cotton-cake	13	0	0
Indian corn meal	13	0	0

The cotton-cake was broken up rather finer than linseed-cake usually is, but it was not reduced to powder. It was part of the same parcel which was bought for the feeding experiments in 1879, was free from mould, and was in good condition.

The bullocks took to it kindly at once, and, as will be shown presently, did very well upon the cake and maize-meal as additional food to roots and chaff.

Decorticated cotton-cake not unfrequently is so hard that fattening bullocks or sheep do not like it; and if forced to eat such cake, they are attacked by diarrhœa, or similar disorders arising from the consumption of indigestible food.

I have never experienced any difficulty in inducing cattle to eat decorticated cotton-cake, and have always found them do well upon a mixture of maize and cotton-cake. I ascribe this good result, in a great measure, to the fact that the decorticated cotton-cake used at Crawley Mill farm is broken up a week or ten days before it is given to stock. The broken cake absorbs moisture from the atmosphere in sufficient proportions to become softened without getting mouldy, if the broken cake is kept in a well-aired barn or outhouse. If the precaution be taken to break up decorticated cotton-cake ten days or a fortnight before use, there is no need of reducing it to powder in order to render it more digestible.

The 3 bullocks in lot 2 consumed from the 14th of January to 17th of March (9 weeks):—

	Cwts.	qrs.	lbs.
Hay-chaff..	9	0	0
Wheat-chaff	4	2	14
Mangolds	33	3	0
Linseed-cake	26	0	0

On an average, each bullock in lot 2 consumed about 15 lbs. of linseed-cake per day, in addition to sliced mangolds, hay, and straw-chaff; whilst the bullocks in lot 1, fed upon the same allowance of mangolds and hay and straw-chaff, consumed about 7½ lbs. of Indian corn and 7½ lbs. of decorticated cotton-cake per head per day.

The following table shows the weight of each of the 6 bullocks on the 14th of January, when put up, and on the 17th of March, 1880, when ready for the butcher:—

Lots.	Bullocks.		Weight of Bullocks on the 14th January, 1880.			Weight of Bullocks on the 17th March, 1880.			Increase in Live-Weight.		
			cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.
1	Fed on decorticated cotton-cake and Maize Meal ..	No. 1	9	2	2	11	0	1	1	1	27
		„ 2	9	3	15	11	1	17	1	2	2
		„ 3	9	3	2	11	0	16	1	1	14
	Total weight of 3 Bullocks ..		29	0	19	33	2	6	4	1	15
2	Fed on Linseed-cake ..	No. 4	9	0	16	10	1	18	1	1	2
		„ 5	9	3	25	11	1	3	1	1	6
		„ 6	9	0	12	10	0	13	1	0	1
	Total weight of 3 Bullocks ..		28	0	25	31	3	6	3	2	9

The 3 bullocks which received as additional food decorticated cotton-cake and maize-meal in equal proportions, it will be seen, increased in 9 weeks as much as 3 qrs. 6 lbs. more in live-weight than the 3 bullocks during the same period fed upon the same quantities of mangolds, hay, and straw-chaff, with the addition of linseed-cake.

On an average each bullock in the cotton-cake and maize-meal lot increased 2·60 lbs. per day; and in the linseed-cake lot, each bullock increased 2·12 lbs. per day.

The bullocks which received decorticated cotton-cake and maize-meal as additional food, not only made more meat than

bullocks in the linseed-cake lot, but the greater increase in live-weight was also obtained at less cost than the increase in the second lot.

The linseed-cake was bought at a cost of 11*l.* 5*s.* per ton, the maize at 7*l.* 15*s.* per ton, and the decorticated cotton-cake at 8*l.* 7*s.* 6*d.* per ton.

Accordingly the cost for the cake and meal used in the two lots was as follows:—

Lots.		Cwts.		£	s.	d.		£	s.	d.
1	Decorticated cotton-cake used in the experiment	13	at	8	7	6	per ton ..	5	8	$10\frac{1}{2}$
	Maize Meal	13	„	7	15	0	„ ..	5	0	$9\frac{3}{4}$
								10	9	$8\frac{1}{4}$
2	Linseed-cake eaten by 3 Bullocks	26	„	11	5	0	„ ..	14	12	6
	Difference in the cost in favour of cotton-cake and maize						..	£4	2	$9\frac{3}{4}$

In the cotton-cake and maize-meal lot the increase, amounting to 491 lbs., was obtained at an expense of 10*l.* 9*s.* $8\frac{1}{4}$*d.* in purchased food, or at a cost in purchased food of $5\frac{1}{8}$*d.* per lb. increase in live-weight; whilst in the case of the 3 bullocks which received as additional food 26 cwts. of linseed-cake, the increase of 401 lbs. was obtained at a cost of 14*l.* 2*s.* $9\frac{3}{4}$*d.* in purchased cake, or at the rate of $8\frac{3}{4}$*d.* per lb.

Fattening Experiments made at Crawley Mill Farm, Woburn, in 1880–81.

Six bullocks, which had consumed a given quantity of mangolds, straw-chaff, decorticated cotton-cake, and maize-meal, and had produced the requisite quantity of dung for the experiments on the continuous growth of wheat and barley, were divided into 2 lots and put in the feeding-boxes on the 26th of November, 1880, after having been weighed.

The following was the weight of each bullock on the 26th of November, 1880:—

Fed on Cotton-cake and Maize. Lot		Cwts.	qrs.	lbs.	*Fed on Linseed-cake.* Lot		Cwts.	qrs.	lbs.
1	No. 1	12	2	20	2	No. 4	11	1	18
	„ 2	12	2	14		„ 5	13	0	6
	„ 3	12	0	10		„ 6	13	0	11
Total weight of 3 Bullocks		37	1	16	Total weight of 3 Bullocks		37	2	7

The two lots of bullocks had the same allowance of sliced mangolds, hay, and hay-chaff. To each bullock, 40 lbs. of sliced mangolds and about $7\frac{1}{2}$ lbs. of hay and hay-chaff was

given per day; besides this fixed daily allowance of roots, hay, and hay-chaff, the bullocks in lot 1 were supplied with as much decorticated cotton-cake and maize-meal as they would eat, and those in lot 2 with as much linseed-cake as they would consume.

After the bullocks were put up in the feeding-boxes a week, each bullock in the first lot consumed about 5 lbs. of decorticated cotton-cake and 5 lbs. of maize-meal daily, and those in lot 2 about 10 lbs. of linseed-cake each per day.

The consumption of cake and meal gradually increased, and after a lapse of 4½ weeks, the first lot ate daily about 11 lbs. of decorticated cotton-cake and 11 lbs. of maize-meal per head, and the second lot about 16 lbs. of linseed-cake each per day.

By that time lot 1 had consumed:—

	Cwts.	qrs.	lbs.
Hay and hay-chaff	6	0	8
Mangolds	34	0	0
Decorticated cotton-cake	8	3	20
Maize-meal	8	3	20

The second lot during the same period consumed the same quantity of roots, hay, and hay-chaff, namely:—

	Cwts.	qrs.	lbs.
Hay and hay-chaff	6	0	8
Mangolds	34	0	0
Linseed-cake	15	1	0

The experiments were continued for a period of 9 weeks, but in the middle of the experimental period the bullocks were weighed, when, with the consumption of the preceding quantities of food, they had made in 4½ weeks the increase shown in the following table:—

Bullocks.		Weight of Bullocks on the 26th Nov., 1880.			Weight of Bullocks on the 28th Dec., 1880.			Increase in Live-weight in 4½ Weeks.		
		Cwts.	qrs.	lbs.	Cwts.	qrs.	lbs.	Cwts.	qrs.	lbs.
Lot 1. Fed on decorticated cotton-cake and Maize-meal.	No. 1	12	2	20	13	3	0	1	0	8
	No. 2	12	2	14	13	2	14	1	0	0
	No. 3	12	0	10	12	3	16	0	3	6
Total weight of 3 bullocks ..		37	1	16	40	1	2	2	3	14
Lot 2. Fed on Linseed-cake.	No. 4	11	1	18	11	3	1	0	1	11
	No. 5	13	0	6	13	3	22	0	3	16
	No. 6	13	0	11	13	2	20	0	2	9
Total weight of 3 bullocks ..		37	2	7	39	1	15	1	3	8

It will be seen that the bullocks fed upon cotton-cake and

maize-meal made 1 cwt. 6 lbs. more live-weight in 4½ weeks than those fed upon linseed-cake, both lots having had the same allowance of mangolds, hay-chaff, and hay.

The next table shows the composition of the three kinds of purchased food used in this experiment:—

	Composition of		
	Decorticated Cotton-cake.	Linseed-cake.	Maize-meal.
Moisture	7·16	14·90	13·99
Oil	16·23	10·90	3·01
*Albuminous compounds	39·44	24·56	9·38
Mucilage, sugar and digestible fibre	24·46	31·97	69·76 (Starch)
Woody fibre (cellulose)	6·30	11·47	2·21
Mineral matter (ash)	6·41	6·20	1·65
	100·00	100·00	100·00
* Containing nitrogen	6·31	3·93	1·50

During the second period of the experiment, or from the 28th of December, 1880, to 21st of January, 1881, the bullocks in lot 1 consumed:—

	Cwts.	qrs.	lbs.
Decorticated cotton-cake	7	0	8
Maize-meal	7	0	8
Mangolds	29	1	0
Hay and hay-chaff	4	1	14

and during the whole experimental period of 9 weeks the food-consumption was the following:—

	Cwts.	qrs.	lbs.
Decorticated cotton-cake	16	0	0
Maize-meal	16	0	0
Mangolds	63	1	0
Hay and hay-chaff	10	1	22

The second lot consumed in the second half of the feeding period, *i.e.* from 28th of December, 1880, to 21st of January, 1881—

	Cwts.	qrs.	lbs.
Linseed-cake	13	3	0
Mangolds	29	1	0
Hay and hay-chaff	4	1	14

and, in the whole experimental period of 9 weeks—

	Cwts.	qrs.	lbs.
Linseed-cake	29	0	0
Mangolds	63	1	0
Hay and hay-chaff	10	1	22

On the 21st of January the bullocks were again weighed,

after having been in the feeding-boxes for a period of 9 weeks, when they were ready for the butcher.

The following table shows the weight of each bullock when put up for experiment on the 26th of November, 1880, and on the 21st of January, 1881, when the experiment was concluded, as well as the increase in live-weight:—

Bullocks.		Weight of Bullocks on the 26th Nov., 1880.			Weight of Bullocks on the 21st Jan., 1881.			Increase in Live-weight in 9 weeks.		
		Cwts.	qrs.	lbs.	Cwts.	qrs.	lbs.	Cwts.	qrs.	lbs.
Lot 1. Fed on decorticated cotton-cake and maize-meal.	No. 1	12	2	20	14	0	18	1	1	26
	No. 2	12	2	14	14	0	19	1	2	5
	No. 3	12	0	10	13	2	0	1	1	18
Total weight of 3 bullocks ..		37	1	16	41	3	9	4	1	21
Lot 2. Fed on Linseed-cake.	No. 4	11	1	18	12	0	20	0	3	2
	No. 5	13	0	6	14	0	25	1	0	19
	No. 6	13	0	11	13	3	19	0	3	8
Total weight of 3 bullocks ..		37	2	7	40	1	8	2	3	1

The linseed-cake was bought at 10*l.* 10*s.* per ton; the decorticated cotton-cake at 8*l.* 7*s.* 6*d.* per ton; the maize-meal at 7*l.* 15*s.* per ton. The purchased food used in fattening the bullocks in lot 1 accordingly cost for

	£	*s.*	*d.*
Cotton-cake	6	14	0
Maize-meal	6	4	0
Total	£12	18	0
The linseed-cake used in Lot 2 cost	15	4	0

Thus it will be seen that the 3 bullocks which were fed on decorticated cotton-cake and maize-meal, in addition to the same allowance of mangolds, hay, and hay-chaff which was given to the second lot, produced 188 lb. more increase in live-weight, at 2*l.* 6*s.* less cost, than the 3 bullocks which received linseed-cake as additional food.

In three successive years a mixture of equal parts of decorticated cotton-cake and maize-meal has produced a larger increase in live-weight and at less cost than linseed-cake.

XXXVI.—*On Compound Engines for Agricultural Purposes.* By Messrs. EASTON and ANDERSON, Consulting Engineers to the Society.

THE enormous demand which springs up for any type of agricultural machinery as soon as its advantages are definitely proved, leads us to watch the introduction of any new principle or invention at the Royal Agricultural Society's Annual Shows with the greatest interest, as we know the development and improvement of a good germ will be rapid, if it is right in principle and suited for meeting a current requirement.

In 1841, at the Liverpool Show, the first portable engine was exhibited. At Derby this year, 66 portable, 25 traction, 10 ploughing, and 139 other steam engines of various types appeared upon the ground, and the production of portables in Lincoln alone must be numbered almost by thousands annually.

Probably the most potent influences which have developed and improved the portable engine have been the public trials of them by the Royal Agricultural Society.

The trials have ceased since the Cardiff Meeting in 1872, as the portable engine has been considered to have then arrived at such a pitch of excellence, that no material advance can have taken place since on the results then obtained. However, there is still plenty of room for improvement, and for greater economy in fuel and water consumption. The working pressure of steam is rising, and would probably rise more rapidly if the Royal Agricultural Society gave more encouragement or sanction to the use of high pressures; and evidently many makers are now seriously contemplating the adoption of the compound cylinder-principle for portable and traction engines.

At Carlisle last year, Messrs. Garrett showed the first compound portable engine which has appeared in the Society's Shows, though Messrs. Fowler had shown a compact 20-horse-power semi-portable compound engine, with cylinders beneath the boiler, at Kilburn, in the previous year.

At the recent Derby Show, Messrs. Garrett, Burrell, Fowler, and Aveling and Porter, all exhibited compound engines, which received due notice from the miscellaneous Judges and Stewards, but could not conveniently be tested this year.

Messrs. Garrett showed a 10-horse-power portable compound engine, with cylinders alongside one another, and cranks at right angles, similar in design to the 8-horse-power engine shown by them at Carlisle last year, a nice arrangement, which will probably be generally adopted, at least in *large* portable engines on the compound principle. They also exhibited an 8-horse-power portable, with two single-acting cylinders placed

one behind the other (commonly called the tandem arrangement), and a single slide-valve, generally more compact, and with fewer working parts than the above, but probably less economical in fuel. Alongside these engines they showed a 16-horse-power horizontal stationary compound engine of the same type as their 10-horse-power portable.

Messrs. Burrell exhibited an 8-horse-power compound traction engine, with two cylinders, one single and the other double-acting, placed tandem, with single slide-valve.

At Messrs. Fowlers' stand was a 16-horse-power semi-portable compound engine, of the same type as theirs at Kilburn, with two cylinders side by side, and cranks at right angles beneath the boiler, an arrangement which is well adapted for winding and other purposes, where it is desired to fix an economical engine quickly, without expensive foundations. They also brought to Derby a compound traction engine, which was seen by those who visited their plough-field, but which was unfortunately too late for the Show itself.

Messrs. Aveling and Porter showed a compound tramway engine, with two tandem cylinders and single slide-valve, arranged in a peculiar manner in accordance with the patent of Mr. Kingdon of Torquay, who has adapted the same type of engine with advantage for driving small steam-launches.

The object of the present article is not so much to describe in detail the engines already exhibited, as to lay before those readers of the 'Journal' who are steam users but not engineers themselves, the salient features and advantages of the compound system in steam-engines; and so to enlist their interest at once in the probable rapid adaptation of the principle to agricultural engines.

In an ordinary high pressure steam-engine the piston is propelled from end to end of the cylinder, by the excess of the pressure exerted on the one side of it, over the resisting pressure of the exhaust on the other. At a certain part of its stroke, the connection with the boiler is shut off, and the volume of steam contained in the cylinder then expands, reducing its pressure at the same time, but still propelling the piston forward, till on arrival at or near the end of the stroke, the slide-valve opens its exhaust port, which permits the steam to escape into the atmosphere (generally with some noisy report), during the return stroke, while steam is admitted to the opposite side of the piston.

With a single eccentric and slide valve, the connection with the boiler is usually shut off when three-fourths of the piston stroke has been accomplished, and the steam expands during the remaining fourth of the stroke, giving with 75 per cent. of a

cylinder full of steam, about 94 per cent. of the power which would have been obtained if steam had been admitted to the cylinder throughout the stroke, thus economising steam and fuel to the extent of about 20 per cent. by even this limited amount of expansion.

With two eccentric and expansion slide-valves, or other more complicated appliances, the steam admission may be cut off much earlier still in the stroke, and still greater economy may be thus obtained. At the Cardiff trials most of the portable engines cut off the steam admission at about $\frac{1}{4}$ to $\frac{1}{5}$ of the stroke, with 80 lbs. boiler pressure.

The higher the boiler pressure, the earlier the steam may be cut off with advantage, and the greater the economy resulting from expansion.

The gear, however, necessary for great expansion in a single cylinder, is always complicated in its details; it easily gets out of adjustment, and it is rarely equable in its action at both ends of a cylinder. An engine too, with high expansion, is difficult to start with the load on, and as steam cools rapidly as it expands, some of the gain from high expansion is lost again by the condensation of the incoming steam in the same cylinder, which has just been cooled nearly to the temperature of the exhaust steam.

This last difficulty is partly but not wholly met by jacketing the cylinder with a steam casing connected with the boiler, which imparts to the steam in the cylinder, as it expands and cools, some extra heat, and at the same time keeps the cylinder warm, for the next incoming "gulp" of live steam. The idea that an air casing or good lagging is as effective as a steam jacket is a decided mistake. They only reduce radiation. The true theory is, that the steam jacket imparts positive heat to the cylinder and to the steam expanding within it.

The compound engine, by the addition of an extra cylinder, enables us to get all the expansion which we desire, with simple valve gear, and the losses from cooling are further neutralised, by dividing the extreme ranges of temperature between two cylinders.

The steam is admitted first to the small high-pressure cylinder to do work against its piston, and thence is exhausted at a medium pressure; then it does about an equal amount of work again, in the low-pressure cylinder of a larger diameter, being finally exhausted into the open air at a pressure slightly above that of the atmosphere.

The general result is, that by adding a small amount to the cylinder weight, with extra piston, slide valve, and other gear of a simple character, we can do the same work as before, with

considerably less steam; and as the steam produced in a given boiler is proportionate to the coal which provides the heat for producing it, the coal used as well as the feed-water required are reduced in exactly the same proportion.

Every agricultural engine requires coal and water to work it; and the conveyance of these commodities to large portable and ploughing engines, in some localities, form material items of expense to the farmer; and traction engines are frequently much delayed in getting them. Consequently from every point of view it is of great importance to use as little as possible of both commodities.

Again, for portability it is important to keep an engine as light as possible. Every horse saved in moving a portable engine from place to place is a gain; and ploughing and traction engines would have fewer enemies among road surveyors and County Boards, and would suffer far less from damages to bridges, &c., if they could be reduced in weight without reducing their power; or when weight is necessary for tractive power, their owners would gain if they could travel farther without refilling their bunkers and tanks. At the same time such advantages would be doubtful gains if they were obtained by means of intricate mechanism impairing the simplicity of an engine.

A smaller but by no means unimportant objection made to traction engines is the violent noise caused by exhausting steam, still at high pressure, into the atmosphere. Those who saw and heard the ploughing and traction engines at Wolverhampton when doing their utmost will well remember this, and engineers can appreciate the waste of steam and fuel which accompanies such noisy demonstrations of doing hard work. Such noise can be almost entirely removed when the steam is well expanded in successive cylinders.

There is a popular impression that increasing the size of an engine cylinder increases its power. As a rule that is not the case, at least for continuous work. The gauge of the power of an engine is nearly always the steam-producing power of its boiler; and in practice very few engines, either marine, land, or locomotive, exist, in which the cylinders are not capable of using vastly more steam than the boiler is capable of making.

So soon as the public can be convinced of this, the tendency will probably be to reduce rather than to increase the cylinder dimensions in ordinary single cylinder engines; and some makers, as Messrs. Fowler, are already advocating this principle in their agricultural engine practice.

The introduction of the compound system will involve the replacement of the present single cylinder by one high-pressure cylinder much smaller, and one low-pressure cylinder some-

what larger than the present one, though in some cases it need not be much larger.

The steam-boiler, with its furnace, and the water contained in it, together with the part of the carriage necessary for supplying these items, necessarily weigh much more than the steam cylinder and its belongings.

An 8-horse-power portable engine, when empty, weighs about 4 tons; of this weight, probably about 3 tons would represent the weight of the boiler with its furnace, and the proportion of the carriage necessary for supporting these items.

Probably the average portable engine in regular work would use as much as 48 lbs. weight of steam per indicated horse-power per hour.

It is probable that the average consumption of steam under similar circumstances, and with the same boiler-pressure, could be reduced 25 per cent. by making the engine compound. This would allow the weight of the boiler and its share of carriage to be reduced to the same extent, viz., from 3 tons to 2 tons 5 cwt.; and if this alteration adds a cylinder with piston and covers weighing 5 cwt., the whole engine may be reduced from 4 to 3½ tons in its weight, when empty; its cost should be certainly no more than before, and the fuel consumption will be reduced 25 per cent.

If at the same time the pressure be increased to 120 or 150 lbs., the extra thickness of boiler plates may make the whole engine as heavy as the original, but its fuel consumption will be further reduced to two-thirds of its former amount.

In a traction or ploughing engine, the relative advantages will be greater still, as in them the water and fuel have to be carried on the engine; and frequently the cost of conveying these commodities is important.

An 8-horse-power traction engine fully equipped for travelling with water and coal weighs about 10 tons, of which probably 8 tons would represent the boiler and furnace with coals and water, and proportion of carriage of these items.

Suppose now that the average consumption of such engines is 48 lbs. weight of steam per indicated horse-power per hour, and that this can be reduced 25 per cent., viz. to 36 lbs. by adding a cylinder weighing, with all its extra belongings, 5 cwts. Then to give the same maximum power, and the same length of journey with bunkers and tank full as before, the boiler, coal, and water may, in virtue of the greater economy, be reduced from 8 to 6 tons, and the nett gain in the gross travelling-weight of the engine will be 1 ton 15 cwts., making it 8 tons 5 cwts. instead of 10 tons; or, with the same weight of coal and water as before, the engine will travel a longer distance by one-third.

There are many other questions affecting these considerations. Among them are the loss of draught when the exhaust escapes into the chimney at a pressure only a little above the atmosphere, which may neutralise the first gain in weight of the boiler by rendering more heating surface and larger tubes necessary; but the above statements show the most salient features of the gain to be anticipated from the use of compound engines.

Probably for large traction engines, two cylinders side by side will be the best arrangement, as an engine will thus become more handy, having no dead centres, and a simple bye-pass arrangement would admit live steam from the boiler to the low-pressure cylinder, to give the maximum power for facing heavy gradients and starting.

It is noteworthy in this place to remind our readers that we in our own practice have used the compound principle in our beam engines for mill purposes and pumping for forty years past; and that during the last fifteen years compound engines have become almost universal for marine purposes. They are now on the eve of being introduced into railway locomotives, and we believe will be very largely used in them in the future, perhaps almost universally.

It is also interesting to note that Mr. Thornycroft, the famous builder of high-speed steam-launches, found years ago that he could reduce the gross weight of his engines, boiler, water, and fuel, to produce a given power for a given time, by using compound in preference to simple engines. If he gained an advantage from such a change, it is reasonable to suppose that traction and ploughing engines may similarly be benefited by it, though it is fair to say that the gain is more important in condensing than in high-pressure engines.

High-pressure steam has a greater effect in promoting economy in a compound than in a simple engine, especially when the exhaust takes place above the atmospheric pressure. It is therefore likely that all makers of compound agricultural engines will eventually adopt a steam-pressure of something like 120 to 150 lbs. We think it well that non-professional men should know that a boiler properly designed for 150 lbs. steam, is as safe as one designed with similar margins of safety for 60 lbs. steam; and we hope the prejudices of the public against high-pressure steam will shortly disappear altogether.

Nearly all railway locomotives and traction engines work at about 150 lbs. pressure, and accidents due to the failure of their boilers from weakness are of extremely rare occurrence.

It may be said, will a compound portable engine, working with 80 lbs. steam, when tried on the brake, beat the economic performances of the Clayton and Shuttleworth and Reading

Ironworks' engines at Cardiff in 1872, working at the same pressure. We must answer that it may be hard work for the compound engine to beat in such a competition. Possibly it would not; but it must be remembered that those results were obtained with elaborate expansion-gear, which would be inadmissible for traction and ploughing engines, and is rarely adopted even now in the portable engine. Moreover, those results were obtained when the engines were new, and practically in perfect order. If competitive trials were renewed after each engine had worked a twelvemonth without overhaul, the comparative results would probably be greatly to the advantage of the compound engine, as the expansion-gear in the simple engine would probably have suffered and be out of adjustment; while if any steam did leak past the first piston and slide-valve of the compound engine, there is every chance that the loss would be nearly regained in the low-pressure cylinder.

Royal Agricultural Society of England.

1881–2.

President.

Mr. J. D. DENT.

Trustees.

Year when Elected.	
1879	H.R.H. The Prince of Wales, K.G., *Marlborough House, Pall Mall*, S.W.
1855	Acland, Sir Thomas Dyke, Bart., M.P., *Sprydoncote, Exeter, Devonshire.*
1857	Bridport, General Viscount, *Cricket St. Thomas, Chard, Somersetshire.*
1850	Chesham, Lord, *Latimer, Chesham, Bucks.*
1863	Kingscote, Colonel, M.P., *Kingscote, Wotton-under-Edge, Gloucestershire.*
1868	Lichfield, Earl of, *Shugborough, Staffordshire.*
1854	Macdonald, Sir Archibald Keppel, Bt., *Woolmer Lodge, Liphook, Hants*
1860	Marlborough, Duke of, K.G., *Blenheim Park, Oxford.*
1839	Portman, Viscount, *Bryanston, Blandford, Dorset.*
1856	Powis, Earl of, *Powis Castle, Welshpool, Montgomeryshire.*
1858	Rutland, Duke of, K.G., *Belvoir Castle, Grantham, Leicestershire.*
1861	Wells, William, *Holmewood, Peterborough, Northamptonshire.*

Vice-Presidents.

1873	Bedford, Duke of, K.G., *Woburn Abbey, Bedfordshire.*
1861	Cathcart, Earl, *Thornton-le-Street, Thirsk, Yorkshire.*
1839	Chichester, Earl of, *Stanmer Park, Lewes, Sussex.*
1867	Devonshire, Duke of, K.G., *Holker Hall, Lancashire.*
1847	Eversley, Viscount, *Heckfield Place, Winchfield, Hants.*
1848	Gibbs, Sir Brandreth, 13, *Pelham Crescent, South Kensington*, S.W.
1858	Kerrison, Sir Edward C., Bart., *Brome Hall, Scole, Suffolk.*
1872	Lathom, Earl of, *Lathom Hall, Ormskirk, Lancashire.*
1848	Lawes, John Bennet, *Rothamsted, St. Albans, Herts.*
1852	Richmond and Gordon, Duke of, K.G., *Goodwood, Chichester, Sussex.*
1859	Vernon, Lord, *Sudbury Hall, Derby.*
1855	Wynn, Sir Watkin Williams, Bart., M.P., *Wynnstay, Ruabon, Denbighshire.*

Other Members of Council.

1881	Allender, G. Mander, *St. Petersburgh Place, Bayswater*, W.
1858	Amos, Charles Edwards, 5, *Cedars Road, Clapham Common, Surrey.*
1877	Arkwright, J. H., *Hampton Court, Leominster, Herefordshire.*
1880	Ashworth, Alfred, *Tabley Grange, Knutsford, Cheshire.*
1875	Aveling, Thomas, *Rochester, Kent.*
1875	Aylmer, Hugh, *West Dereham, Stoke Ferry, Norfolk.*
1863	Bowly, Edward, *Siddington House, Cirencester, Gloucestershire.*
1874	Chandos-Pole-Gell, H., *Hopton Hall, Wirksworth, Derbyshire.*
1860	Druce, Joseph, *Eynsham, Oxford.*
1871	Egerton, Hon. Wilbraham, M.P., *Rostherne Manor, Knutsford, Cheshire.*
1873	Evans, John, *Uffington, Shrewsbury, Salop.*
1876	Feversham, Earl of, *Duncombe Park, Helmsley, Yorkshire.*
1879	Foster, S. P., *Killhow, Carlisle, Cumberland.*

Year when Elected.	
1875	Frankish, William, *Limber Magna, Ulceby, Lincolnshire.*
1881	Gilbey, Walter, *Elsenham Hall, Bishop's Stortford.*
1879	Gorringe, Hugh, *Kingston-by-Sea, Shoreham, Sussex.*
1874	Hemsley, John, *Shelton, Newark, Notts.*
1876	Howard, Charles, *Biddenham, Bedford.*
1878	Howard, James, M.P., *Clapham Park, Bedfordshire.*
1871	Jones, J. Bowen, *Ensdon House, Montford Bridge, R.S.O., Salop.*
1869	Leeds, Robert, *Keswick Old Hall, Norwich.*
1872	Leicester, Earl of, K.G., *Holkham Hall, Wells, Norfolk.*
1874	Lindsay, Colonel Sir R. Loyd, M.P., *Lockinge Park, Wantage, Berkshire.*
1865	Lopes, Sir Massey, Bart., M.P., *Maristow, Roborough, Devon.*
1874	Martin, Joseph, *Highfield House, Littleport, Isle of Ely, Cambridgeshire.*
1880	Moreton, Lord, M.P., *Tortworth Court, Falfield, R.S.O., Gloucestershire.*
1879	Neville, Robert, *Butleigh Court, Glastonbury, Somersetshire.*
1857	Pain, Thomas, *Audley's Wood, Basingstoke, Hants.*
1881	Parker, Hon. Cecil T., *Evershot, Dorset.*
1861	Randell, Charles, *Chadbury, Evesham, Worcestershire.*
1875	Ransome, Robert Charles, *Ipswich, Suffolk.*
1867	Ravensworth, Earl of, *Ravensworth Castle, Durham.*
1871	Rawlence, James, *Bulbridge, Wilton, Salisbury, Wilts.*
1869	Ridley, Sir M. White, Bart., M.P., *Blagdon, Cramlington, Northumberland.*
1875	Russell, Robert, *Horton Court Lodge, Dartford.*
1874	Sanday, George Henry, *Wensley House, Bedale, Yorkshire.*
1878	Sheraton, William, *Broom House, Ellesmere, Salop.*
1856	Shuttleworth, Joseph, *Hartsholme Hall, Lincoln.*
1874	Spencer, Earl, K.G., *Althorp, Northampton.*
1875	Stratton, Richard, *The Duffryn, Newport, Monmouthshire.*
1874	Turbervill, Lieut.-Col. Picton, *Ewenny Priory, Bridgend, South Wales.*
1845	Turner, George, *Great Bowley, Tiverton, Exeter, Devonshire.*
1871	Turner, Jabez, *Norman Cross, Huntingdonshire.*
1871	Wakefield, William H., *Sedgwick, Kendal, Westmoreland.*
1870	Whitehead, Charles, *Barming House, Maidstone, Kent.*
1865	Wilson, Jacob, *Woodhorn Manor, Morpeth, Northumberland.*
1878	Wise, George, *Woodcote, Warwick.*

Secretary and Editor.

H. M. JENKINS, 12, *Hanover Square, London,* W.

Consulting Chemist—Dr. Augustus Voelcker, F.R.S., 12, *Hanover Square,* W.

Consulting Botanist—W. Carruthers, F.R.S., F.L.S., *Central House, Central Hill,* S.E.

Consulting Veterinary Surgeon—Professor James Beart Simonds, *Royal Veterinary College, Camden Town,* N.W.

Veterinary Inspectors—The Officers of the Royal Veterinary College.

Consulting Engineers—Eastons & Anderson, 3, *Whitehall Place,* S.W.

Consulting Surveyor—George Hunt, *Evesham, Worcestershire.*

Seedsmen—Thomas Gibbs and Co., *Corner of Halfmoon Street, Piccadilly,* W.

Publisher—John Murray, 50, *Albemarle Street,* W.

Bankers—The London and Westminster Bank, *St. James's Square Branch,* S.W.

STANDING COMMITTEES FOR 1881.

Finance Committee.

Kingscote, Colonel (Chairman).
Bridport, General Viscount.
Ridley, Sir M. White, Bt.
Frankish, W.
Randell, Charles.
Shuttleworth, J.

House Committee.

The President.
Chairman of Finance Committee.
Bridport, General Viscount.
Gibbs, Sir Brandreth.
Kingscote, Colonel.
Ridley, Sir M. White, Bt.
Shuttleworth, J.

Journal Committee.

Dent, J. D. (Chairman).
Cathcart, Earl.
Ridley, Sir M. White, Bt.
Chandos-Pole-Gell, H.
Frankish, W.
Hemsley, J.
Howard, J.
Jones, J. Bowen.
Kingscote, Colonel.
Ransome, R. C.
Turbervill, Lieut.-Col.
Wells, W.
Whitehead, Charles.
Wise, G.

Chemical Committee.

Macdonald, Sir A. K., Bt. (Chairman).
Bedford, Duke of.
Vernon, Lord.
Arkwright, J. H.
Aveling, T.
Carruthers, W.
Dent, J. D.
Howard, C.
Jones, J. Bowen.
Lawes, J. B.
Neville, R.
Turbervill, Lieut.-Col.
Voelcker, Dr. A.
Wakefield, W. H.
Warren, R. A.
Wells, William.
Whitehead, Charles.

Seeds and Plant-Diseases Committee.

Whitehead, Charles (Chairman).
Vernon, Lord.
Gibbs, Sir Brandreth.
Ashworth, A.
Carruthers, W.
Frankish, W.
Jones, J. Bowen.
Turbervill, Lieut.-Col.
Voelcker, Dr.

Veterinary Committee.

Egerton, Hon. Wilbraham (Chairman).
Bridport, General Viscount.
Ridley, Sir M. White, Bt.
Gibbs, Sir Brandeth.
Ashworth, A.
Brown, Professor.
Chandos-Pole-Gell, H.
Duguid, W.
Fleming, George.
Foster, S. P.
Gorringe, H.
Harpley, M. J.
Kingscote, Colonel.
Lindsay, Colonel Loyd.
Sanday, G. H.
Sanderson, Dr. J. Burdon.
Simonds, Professor.
Stratton, R.
Wakefield, W. H.
Wilson, Jacob.

Stock-Prizes Committee.

Chandos-Pole-Gell, H. (Chairman).
Bridport, Gen. Viscount.
Gibbs, Sir Brandreth.
Arkwright, J. H.
Ashworth, A.
Aylmer, H.
Bowly, Edward.
Evans, John.
Frankish, W.
Gorringe, H.
Hemsley, J.
Howard, C.
MacIntosh, D.
Pain, T.
Randell, C.
Sanday, G. H.
Sheraton, R.
Simonds, Prof.
Stratton, R.
Turner, George.
Wakefield, W. H.
Wilson, Jacob.
Wise, G.
The Stewards of Live Stock.

Implement Committee.

Bridport, Gen. Viscount.
Vernon, Lord.
Gibbs, Sir Brandreth.
Anderson, W.
Aveling, T.
Frankish, W.
Gorringe, H.
Hemsley, J.
Howard, C.
Howard, J.
Jones, J. Bowen.
Martin, J.
Neville, R.
Ransome, R. C.
Rich, W. E.
Sanday, G. H.
Sheraton, W.
Shuttleworth, Joseph.
Stratton, R.
Turbervill, Lieut.-Col.
Turner, Jabez.
Wilson, Jacob.
The Stewards of Implements.

General Derby Committee.

Bedford, Duke of (Chairman).
Bridport, Gen. Viscount
Cathcart, Earl.
Moreton, Lord.
Vernon, Lord.
Ridley, Sir M. W., Bt.
Egerton, Hon. W.
Gibbs, Sir Brandreth.
Ashworth, A.
Aveling, T.
Aylmer, H.
Chandos-Pole-Gell, H.
Coke, Hon. E.
Coleman, J.
Corbett, Geo.
Dent, J. D.
Foster, S. P.
Frankish, W.
Gorringe, H.
Hemsley, J.
Hobson, Alderman.
Howard, C.
Jones, J. Bowen.
Kingscote, Colonel.
Mayor of Derby.
Murray, G.
Neville, R.
Randell, Charles.
Sanday, G. H.
Sheraton, W.
Shuttleworth, J.
Smith, Alderman J.
Troutbeck, G.
Turbervill, Lieut.-Col.
Turner, Alderman.
Wade, S.
Wakefield, W. H.
Whitehead, Charles.
Wilson, Jacob.
Wise, Geo.

Show-Yard Contracts Committee.

Shuttleworth, Joseph (Chairman).
Gibbs, Sir Brandreth.
Amos, C. E.
Aveling, T.
Chandos-Pole-Gell, H.
Frankish, W.
Hemsley, J.
Howard, C.
Randell, Charles.
Sanday, G. H.
Stratton, R.
Wilson, Jacob.

Committee of Selection.

Cathcart, Earl.
Bridport, Gen. Viscount.
Ridley, Sir M. W., Bt.
Frankish, W.
Howard, C.
Turbervill, Lieut.-Col.
Wilson, Jacob.

And the Chairmen of the Standing Committees.

Education Committee.

Bedford, Duke of.
Moreton, Lord.
Aveling, T.
Dent, J. D.
Carruthers, W.
Jones, J. Bowen.
Kingscote, Colonel.
Turbervill, Lieut.-Col.
Voelcker, Dr.
Wise, Geo.

Cattle Plague Committee.

The whole Council.

*** The President, Trustees, and Vice-Presidents are Members *ex officio* of all Committees.

Royal Agricultural Society of England.

GENERAL MEETING,

12, Hanover Square, Monday, May 23rd, 1881.

REPORT OF THE COUNCIL.

The Council regret to announce that the number of Members of the Society during the past year has been seriously diminished by the resignation of no less than 216, as well as by the death of 3 Governors and 43 Members, and the removal of 40 Members from the list by order of the Council. Since the last General Meeting in December these deficiencies have been partially repaired by the election of 199 Members.

The Society now consists of:—

85 Life Governors,
69 Annual Governors,
2765 Life Members,
5041 Annual Members,
19 Honorary Members,

making a total of 7979, and showing a decrease of 103 since the December General Meeting.

The Council have recently sustained a great loss by the death of three valued colleagues,—Mr. Odams, Mr. Cantrell, and Mr. D. R. Davies. The vacancy caused in the first case has been filled up by the election of Mr. G. Mander Allender, of Saint Petersburgh Place, Bayswater, the second is still under consideration, and the third will be filled up by the vote of the Members by ballot to-day.

The accounts for the year 1880 have been examined and certified by the auditors and accountants of the Society, and have been published in the last number of the 'Journal,' together with the statement of Receipts and Expenditure of the Carlisle

Meeting. The funded property of the Society remains the same as at the end of last year, namely 12,430*l.* 7*s.* New Three per Cents. The balance of the current account in the hands of the Society's bankers on the 1st instant was 3398*l.* 14*s.* 9*d.* and 2000*l.* remained on deposit. These sums are destined to defray part of the expenses of the forthcoming Derby Meeting.

The Derby Meeting will commence on Wednesday, July 13th, and will close on Monday July 18th,—the Council having reverted to the practice which has proved so successful on former occasions, when the Country Meeting has been held in large industrial centres, of making Saturday and Monday the days of cheap admission.

The Derby Local Committee have added to the Society's Prize-list offers of numerous Prizes for horses eligible for entry in the English Cart-horse Society's Stud-book, as well as Prizes for Hackneys and Hunters, Dairy Cattle, Cheese, and Butter. The entries having been closed, the Council are able to state generally that there is every prospect of the Derby Show being well worthy of the central locality in which it will be held, both as regards the number and the variety of the exhibits.

The success which attended the exhibition of Dairy Machinery at work at Kilburn and Carlisle, has induced the Council to make special arrangements for a Working Dairy in the Derby Showyard, with a view to render it, if possible, more instructive than heretofore, without being less attractive.

The district assigned for the Country Meeting of 1882, comprises the counties of Berks, Cornwall, Devon, Dorset, Hants, Kent, Somerset, Sussex, Surrey, and Wilts; and the Council have accepted a very cordial invitation which they received from the Mayor and Corporation of Reading to hold the Show next year in that locality. The site offered has the advantages of being at a considerable elevation, having a porous subsoil, and being in immediate contiguity to one of the main lines of railway.

In accordance with the usual rotation of districts, the Country Meeting for 1883 will be held in the district which consists of the county of York.

The diseases of animals of the farm have occupied a large share of the attention of the Council during the past five months, more especially the recent severe outbreak of foot-and-

mouth disease. They have represented to the Privy Council the danger to our home flocks and herds which arises from the cattle markets at Smithfield and Deptford being held on the same day, and also the necessity of more careful disinfection of persons employed in the Foreign Cattle Market before they are allowed to attend English cattle. While thankfully recognising the prompt action taken by the Privy Council to restrict the outbreak of foot-and-mouth disease, they have urged the Privy Council to call the attention of the Governments of France and other foreign countries to the serious losses which have been sustained by English agriculturists in consequence of the importation of that disease with certain cargoes of cattle from France, and to press upon those Governments the necessity of careful inspection at the port of embarkation of all animals exported from their dominions to the United Kingdom.

The investigation into the causes of Sheep-rot, and the practical inquiry into the circumstances attending the outbreaks of the last two years, which were announced as in progress at the last General Meeting, have been actively pursued; and in the recently issued number of the 'Journal' will be found a first instalment of the report on the former branch of the inquiry, and a complete account of the latter.

At the Brown Institution the experiments on Anthrax have been continued by Dr. Greenfield, and have led to the conclusion that animals may be protected from this disease by inoculation with cultivated virus, which produces a mild type of the disorder, and renders the animal thus treated insusceptible of a further attack. A report on these experiments has been published in the number of the 'Journal' just issued, and it is expected that a further and probably a final report will be published in the autumn.

Four Graduates of the Royal College of Veterinary Surgeons presented themselves last January, to compete for the Society's Medals and Prizes offered for proficiency in Cattle Pathology. The Examiners adjudicated the Gold Medal and First Prize to Mr. R. A. Rumboll, of 2, Pennywell Road, Bristol; the Silver Medal and Second Prize to Mr. W. J. Malvern, of Ross, Herefordshire; and the Bronze Medal and Third Prize to Mr. E. J. Johnson, of South Anston, Rotherham.

The Council take this opportunity of reminding Exhibitors of Cattle that, after the forthcoming Show at Derby, the new rule relating to the ages of animals exhibited will come into force—namely, that the Cattle classes in the Prize-sheet will be arranged according to the years in which the animals are born.

The Council have also decided to place a maximum limit of age in certain classes, as follows:—

Aged Draught Stallions to be four years and not more than seven years old in the year of the Show.

Hackney and Pony Stallions to be limited to seven years old in the year of the Show.

Aged Bulls to be above three and not exceeding six years old.

Rams to be arranged as Shearling Rams and Two-Shear Rams.

Aged Boars to be above twelve months and not exceeding three years old at the time of the Show.

In consequence of the appointment of a Select Committee of the House of Commons to inquire into the subject of Railway Rates and Fares, the Council have appointed a Special Committee to collect evidence and to nominate witnesses to give evidence thereon.

The work of the Laboratory continues to increase, and has amply justified the expenditure the Council has incurred in its establishment.

The Woburn experiments have now been continued for four years, and in addition to the usual annual report, the Council have, with a view to render them more instructive, decided to invite Members of the Society to an Annual Inspection in connection with the General Meeting in May. They trust that the Members of the Society will avail themselves themselves largely of this opportunity to observe the effects of the different manures upon the various crops, and to hear the explanations given by the Society's Scientific Officers.

Ten candidates out of twelve who had entered their names, presented themselves for Examination for the Society's Prizes and Certificates on the 10th inst. and four following days.

Three candidates obtained the First Class Certificate, the Life Membership of the Society, and Prizes as follows:—

Mr. P. Turnbull, of the Royal Agricultural College, Cirencester, First Prize of 25*l*.

Mr. B. Furnivall, of the Surrey County School, Second Prize of 15*l*.

Mr. C. Waterer, of the Royal Agricultural College, Cirencester, Third Prize of 10*l*.

Mr. A. Hardie, of the Royal Agricultural College, Cirencester, obtained a Second Class Certificate.

By Order of the Council,

H. M. JENKINS,

Secretary.

ROYAL AGRICULTURAL

DR. HALF-YEARLY CASH ACCOUNT

	£ s. d.	£ s. d.	£ s. d.
To Balance in hand, 1st January, 1881:—			
Bankers		301 19 2	
Secretary		44 3 11	
			346 3 1
To Income:—			
Dividends on Stock		181 15 11	
Subscriptions:—			
Governors' Annual	280 0 0		
Members' Life-Compositions	617 0 0		
Members' Annual	3,691 16 6		
		4,588 16 6	
Establishment:—			
Rent		200 0 0	
Journal:—			
Sales	83 8 7		
Advertisements	49 16 5		
		133 5 0	
Chemical:—			
Laboratory Fees		157 11 3	
Veterinary:—			
Professional Fee		0 10 6	
Carlisle Meeting		69 18 6	
Total Income		.. .. ..	5,331 17 8
To Derby Meeting		.. .. ..	6,963 8 11
			£12,641 9 8

BALANCE-SHEET,

LIABILITIES.		£ s. d.	£ s. d.
To Capital:—			
Surplus, 31st December, 1880		17,831 8 6	
Surplus of Income over Expenditure during the Half-year, viz.:—	£ s. d.		
Income	5,331 17 8		
Expenditure	3,326 7 11		
		2,005 9 9	
			19,856 18 3
Deduct half-year's interest and depreciation on Country Meeting Plant		.. .. ..	203 8 6
			£19,683 9 9

QUILTER, BALL, CROSBIE, GLEGG, & WELTON, *Accountants.*

SOCIETY OF ENGLAND.

FROM 1ST JANUARY TO 30TH JUNE, 1881. Cr.

	£ s. d.	£ s. d.	£ s. d.
By Expenditure:—			
Establishment:—			
Salaries, Wages, &c.	770 10 0		
House:—Rent, Taxes, &c.	348 7 11		
Office:—Printing, Postage, Stationery, &c.	289 19 11		
		1,408 17 10	
Journal:—			
Printing and Stitching	494 12 2		
Postage and Delivery	200 0 0		
Advertising	8 19 3		
Literary Contributions	114 11 0		
Lithographing	5 10 0		
		823 12 5	
Chemical:—			
Salaries	452 10 0		
Fittings for Laboratory	10 2 2		
Apparatus	16 2 1		
Petty Payments	10 0 0		
		488 14 3	
Veterinary:—			
Prizes and Medals	47 12 0		
Fees to Examiners	21 16 9		
Professional Fees	8 16 6		
		78 5 3	
Botanical:—			
Consulting Botanist's Salary		50 0 0	
Education:—			
Fees to Examiners	52 10 0		
Printing and Advertising	28 17 4		
Prizes	50 0 0		
		131 7 4	
Farm Inspection:—			
Advertising		55 12 2	
Sundries:—			
Medals for Corn Competition	3 12 0		
Expenses ditto	5 3 0		
Collecting Evidence for Railway Commission	66 19 8		
		75 14 8	
Subscriptions (paid in error) returned		2 0 0	
London Exhibition		35 13 0	
Carlisle Meeting		176 11 0	
Total Expenditure			3,326 7 11
By Derby Meeting			5,093 17 7
By Balance in hand, 30th June:—			
Bankers	2,155 2 3		
Secretary	66 1 11		
		2,221 4 2	
At Deposit		2,000 0 0	
			4,221 4 2
			£12,641 9 8

30TH JUNE, 1880.

ASSETS.	£ s. d.	£ s. d.
By Cash in hand	2,221 4 2	
By New 3 per Cent. Stock 12,430*l.* 7*s.* 0*d.* cost*	11,677 17 1	
By Books and Furniture in Society's House	1,451 17 6	
By Country Meeting Plant	2,509 0 1	
By Deposit Account	2,000 0 0	
		19,859 18 10
Less at credit of Derby Meeting		176 9 1
		£19,683 9 9

* *Value at* 100 = £12,430 7*s.* 0*d.*

Mem.—The above Assets are exclusive of the amount recoverable in respect of arrears of Subscription to 30th June, 1881, which at that date amounted to 2,568*l.*

Examined, audited, and found correct, this 22nd day of August, 1881.

FRANCIS SHERBORN,
A. H. JOHNSON, } *Auditors on behalf of the Society.*

DERBY MEETING,

1881.

STEWARDS OF DEPARTMENTS.

Implements.

Robert Neville.
Lord Vernon.
J. Powen Jones.

Stock.

Charles Whitehead.
Charles Howard.
J. D. Dent.
S. P. Foster.

Butter and Dairying.

G. M. Allender.

Forage.

H. Chandos-Pole-Gell.

General Arrangements.

Jacob Wilson.

JUDGES OF STOCK.

HORSES.

Agricultural.

Henry Smith.
Benjamin Spraggon.
V. B. Watts.

Clydesdale.

David Alston.
Adam Smith.

Suffolk.

B. W. Cooper.
S. Craske Roper.

Hunter.

John B. Booth.
Edward Knott.
Thomas Mansell.

Hackney.

Robert Aldworth.
William Flanders.
Jacob Smith.

CATTLE.

Shorthorn.

George Drewry.
L. C. Chrisp.
William Sanday.

Hereford.

J. Crane.
Francis Evans.

Devon, Sussex, Norfolk, and Suffolk Polled.

Stephen Bailey.
Thomas Cooper.
Henry Overman.

Longhorn and Dairy Cattle.

Edmund Lythall.
John Treadwell.

Jersey and Guernsey.

Walter Gilbey.
James Ross.
C. Stephenson.

SHEEP.

Leicester, Lincoln, and Long-woolled.

JOHN TURNER.
GEORGE WALMSLEY.

Cotswold, Kentish, Romney Marsh, Devon, and other Long-woolled.

W. H. FLETCHER.
THOMAS PORTER.

Oxfordshire Down.

JOHN BRYAN.
WILLIAM JONAS.

Shropshire.

JOHN COXON.
JOHN EVANS.

Southdown and other Short-woolled.

JOHN FORD.
EDWARD LITTLE.

PIGS.

JOHN ANGUS.
ALFRED ASHWORTH.
JOSEPH SMITH.

INSPECTORS OF SHEARING.

WILLIAM JOBSON. | J. E. RAWLENCE. | J. B. WORKMAN.

JUDGES OF CHEESE.

GEORGE LEWIS. | THOMAS SMITH. | JOHN STAFFORD.

JUDGES OF BUTTER.

BENJAMIN BRINDLEY. | JAMES WATSON.

JUDGES OF BEE-KEEPING APPLIANCES.

REV. EDWARD BARTRUM. | WILLIAM CARR. | THOMAS W. COWAN.

JUDGES OF IMPLEMENTS.

JOHN COLEMAN. | J. W. KIMBER. | WILLIAM SCOTSON.

JUDGES OF FARMS.

W. P. J. ALLSEBROOK. | GEORGE GIBBONS. | CLARE SEWELL READ.

AWARDS OF PRIZES.

NOTE.—The Judges were instructed, in addition to awarding the Prizes, to designate as the *Reserve Number* one animal in each Class, next in order of merit, if it possessed sufficient for a Prize; in case an animal to which a Prize was awarded should subsequently become disqualified.

Prizes given by the Derby Local Committee are marked thus (*).

HORSES.

Agricultural Stallions—Four Years old and upwards.

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: FIRST PRIZE, 25*l.*, for "Admiral" (71), bay, 5 years-old; bred by Mr. J. Milner, Kirkham, Lancashire; sire, "Honest Tom" (1105); dam by "British Ensign" (272).

Agricultural Stallions—Three Years old.

WALTER GILBEY, Elsenham Hall, Bishops Stortford, Herts; FIRST PRIZE, 20*l.*, for "Spark," black; bred by Mr. W. R. Rowland, Aylesbury, Bucks; sire, "Colonel" (2101); dam, "Daisy," by "King Charles" (1207).

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: SECOND PRIZE, 10*l.*, for "Prime Minister" (2479), bay; bred by Mr. J. Tibbet, Doddington, Cambridgeshire; sire, "Lord Beaconsfield" (115); dam, by "Matchless" (1531): and the *Reserve Number* for "Worsley Wonder" (2519), bay; bred by Mr. J. Fryer, Chatteris; sire, "British Wonder" (278); dam by "Honest Tom" (1121).

Agricultural Stallions—Two Years old.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 15*l.*, for "Emperor," brown; bred by Mr. R. Ward, Uppingham, Rutland; sire, "Stonton" (2065); dam by "Champion" (441).

GARRETT TAYLOR, Trowse House, Norwich: SECOND PRIZE, 10*l.*, for "Invincible Wonder," chestnut; bred by Mr. Green, Montgomeryshire; sire, Marster's "England's Wonder" (761); dam by "Noble Gold-Finder" (1643).

THE EARL OF ELLESMERE, Worsley Hall: THIRD PRIZE, 5*l.*, for "Silent James," bay; bred by Mr. R. Porter, Fleetwood, Lancashire; sire, "What's Wanted" (2332); dam by "Honest Tom" (1105): and the

Reserve Number and *Highly Commended* for "King William," brown; bred by himself; sire, "William the Conqueror" (2343); dam by Barton's "Champion."

Clydesdale Stallions—Four Years old and upwards.

JOHN DASHWOOD LANG, Knowle, Sidmouth, Devonshire: FIRST PRIZE, 25*l*., for "Black Watch" (64), black, 7 years-old; bred by Mr. W. Imrie, Blackhill, Maryhill, Glasgow, N.B.; sire, "Crown Prince" (206); dam, "Flora," by "Young Lofty" (987).

JAMES WHYTE, Aldboro' Hall, Darlington, Co. Durham: SECOND PRIZE, 10*l*., for "Pointsman" (1236), bay, 4 years-old; bred by himself; sire, "Tam O'Shanter" (851); dam, "Rose," by "Lord Derby."

Clydesdale Stallions—Three Years old.

ANDREW MONTGOMERY, Boreland, Castle Douglas, Kirkcudbright, N.B.: FIRST PRIZE, 20*l*., for "The MacGregor" (1487), bay; bred by Mr. R. Craig, Flashwood, Dalry, Ayrshire, N.B.; sire, "Darnley" (222); dam, "Sally" (60), by "Prince Charlie" (629).

GEORGE RODGER, Arden House, Altrincham, Cheshire: SECOND PRIZE, 10*l*., for "Drumpellier" (1428), brown; bred by Mr. John Hendrie, of Larbert, Glasgow, N.B.; sire, "Druid" (1120); dam, "Maid of the Mill" (248), by "Glasgow Geordie" (349).

THE DUKE OF PORTLAND, Welbeck Abbey, Worksop, Notts: THIRD PRIZE, 5*l*., for "Pure Bone" (1510), bay; bred by Mr. A. Lang, Garneyland Farm, Paisley, Renfrewshire; sire, "Ivanhoe" (396); dam, "Paisley Jean" (209), by "Prince of Wales" (670).

JOHN DARLING, Beau-Desert, Rugeley, Staffs.: the *Reserve Number* to "Monkbarns," bay; bred by Mr. J. M. Martin, Auchendennan, Balloch, N.B.; sire, "Farmer" (286); dam, "Knockdon" (242), by "Justice" (421).

Suffolk Stallions—Four Years old and upwards.

SAMUEL WOLTON, Butley Abbey, Wickham Market, Suffolk: FIRST PRIZE, 25*l*., for "Chieftain" (1354), chestnut, 4 years-old; bred by himself; sire, "Cupbearer 2nd" (278); dam, "Princess" (1095), by "Warrior" (1353).

RICHARD GARRETT, Carleton Hall, Saxmundham, Suffolk: SECOND PRIZE, 10*l*., for "Crown Prince" (564), chestnut, 8 years-old; bred by the late Mr. A. K. Blofield, Crown Farm, Leiston, Suffolk; sire, "Cupbearer" (416); dam by "Goliath" (69).

HORACE WOLTON, Newbourn Hall, Woodbridge, Suffolk: the *Reserve Number* and *Highly Commended* for "Royalty" (1339), chestnut, 10 years-old; bred by himself; sire, "Magnum Bonum" (1347); dam, "Duchess" (1032), by "Warrior" (1353).

Suffolk Stallions—Three Years old.

EARL HOWE, Gopsall, Atherstone: FIRST PRIZE, 20*l*., for "Kilburn," chestnut; bred by himself; sire, Lord Bradford's "Viceroy;" dam, "Scott," by Walker's "Captain."

Suffolk Stallions—Two Years old.

HORACE WOLTON, Newbourn Hall, Woodbridge: FIRST PRIZE, 15*l*., for

"Vivacity," chestnut; bred by himself; sire, "Proctor" (285); dam, "Victoria of Newbourn" (1055), by "Royal Duke 2nd" (1366).

SAMUEL WOLTON, Butley Abbey, Wickham Market: SECOND PRIZE, 10*l.*, for "Chief of the East," chestnut; bred by himself; sire, "Tipton" (1367); dam, "Princess" (1095), by "Warrior" (1353).

WILLIAM WILSON, Baylham Hall, Ipswich, Suffolk: the *Reserve Number* to "Light Heart," chestnut: bred by Mr. J. Lawton, Darmsden, Needham Market, Suffolk; sire, "Farmer;" dam by "Sargent's Bumper."

Thoroughbred Stallions suitable for getting Hunters.

HENRY V. WEBSTER AND THE EXECUTORS OF H. L. HOLT, Northallerton, Yorkshire: FIRST PRIZE, 25*l.*, for "Glenfillan," black, 8 years-old; bred by Mr. J. Johnston, Sheffield Lane Paddocks.

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: SECOND PRIZE, £15, for "Shifnal," brown, aged; bred by Mr. John Eyke, Stanton, Shifnal, Salop; sire, "Saccharometer;" dam, "Countess Amy," by "St. Albans."

Stallions suitable for getting Hackneys above 14 *hands* 2 *inches and not exceeding* 15 *hands* 2 *inches.*

JOHN BURTON BARROW, Thurgarton Priory, Southwell, Notts: FIRST PRIZE, 20*l.*, for "Young Perfection," brown, 7 years-old; bred by Mr. W. Utting, Melton Parva, Norwich; sire, "Old Perfection;" dam by "Don Carlos."

Pony Stallions, above 13 *hands* 2 *inches and not exceeding* 14 *hands* 2 *inches.*

CHRISTOPHER W. WILSON, Rigmaden Park, Carnforth: FIRST PRIZE, 15*l.*, for "Little Wonder," brown, 9 years-old; bred by Mr. Armes, Norfolk; sire, "Confidence."

JAMES FIRTH CROWTHER, Knowl Grove, Mirfield, Yorkshire: SECOND PRIZE, 10*l.*, for "Nobby," chestnut, 3 years-old; bred by Mr. Robert Cowton, Potter Brompton, Ganton, Yorkshire; sire, "Calcutta;" dam by Triffett's "Fireaway."

MANSFIELD ROBERT SANDERSON, Percy Road, Pocklington, Yorkshire: THIRD PRIZE, 5*l.*, for his chestnut, 2 years-old; bred by himself; sire, "Denmark;" dam by "All-Fours."

CHARLES YEALAND, Calverton, Notts.: the *Reserve Number* to "Pride of the Forest," brown, 4 years-old; bred by himself; sire, "Whalebone;" dam, "Sweet Alice," by "Pride of the Isle."

Agricultural Mares and Foals.

FREDERICK PLATT, Barnby Manor, Newark, Notts: FIRST PRIZE, 20*l.*, for "Princess," bay, aged (foal by "Albert Edward" 2384); bred by Mr. John Hooper, North Side, Whittlesea; sire, "Emperor 2nd" (697); dam by "England's Glory."

THE EARL OF ELLESMERE, Worsley Hall: SECOND PRIZE, 10*l.*, for "Beauty," brown, 12 years-old (foal by "Worsley Wonder" 2519); bred by Mr. Griffin, Peterborough; sire, "Comet."

THE HON. E. K. W. COKE, Longford Hall, Derby: THIRD PRIZE, 5*l.*, for "Cinderella," black, 9 years-old (foal by "Candidate"); bred by Mr.

Badrick, Bierton, Aylesbury, Bucks; sire, "Black Prince" (166); dam, "Flower."

George Rodger, Arden House, Altrincham, Cheshire: the *Reserve Number* and *Highly Commended* for "Mystery," brown, 6 years-old (foal by "Drumpellier" 1428); bred by Mr. John Paterson, Moffat, N.B.; sire, "Craigie Lea" (204).

Clydesdale Mares and Foals.

The Hon. Walter Stuart, Shottle Hall, Derby: First Prize, 20*l.*, for "Queen Mary," bay, 6 years-old (foal by "Druid" 1120); bred by Mr. J. Waddell, Bathgate, Linlithgow, N.B.; sire, "Topsman"; dam, "Jean," by "Sir Walter."

The Marquess of Londonderry, Seaham Hall, Seaham Harbour, co. Durham: Second Prize, 10*l.*, for "Flora," bay, 5 years-old (foal by "Topgallant"); bred by Messrs. Maxwell, Ingleston, Durrisdeer, Dumfrieshire; sire, "Lochryan;" dam by "Lord Byron."

George Rodger, Arden House, Altrincham, Cheshire: Third Prize, 5*l.*, for "Bell" (366), bay, 7 years-old (foal by "Drumpellier" 1428); bred by Mr. James Findlay, Ross, Kirkcudbright, N.B.; sire, "Emperor" (277); dam by "Lochfergus Champion" (449).

Edward and Alfred Stanford, Eatons, Ashurst, Steyning, Sussex: the *Reserve Number* to "Bella," bay, 5 years-old (foal by "Young Topsman" 1038); bred by themselves; sire, "The Duke" (860); dam, "Venture," by "Napoleon."

Suffolk Mares and Foals.

Daniel Abbot Green, East Donyland Place, Colchester, Essex: First Prize, 20*l.*, for "Smart," chestnut, 11 years-old (foal by "Royalty" 1339); bred by himself; sire, "President" (1865); dam, "Darby."

Horace Wolton, Newbourn Hall, Woodbridge, Suffolk: Second Prize, 10*l.*, for "Queen of Newbourn" (1049), chestnut, 6 years-old (foal by "Cupbearer 3rd"); bred by himself; sire, "Snap" (142); dam, "Duchess" (1032), by "Warrior" (1353).

The Duke of Hamilton and Brandon, K.T., Easton Park, Wickham Market: Third Prize, 5*l.*, for "Bright Diamond," chestnut, 9 years-old; (foal by "Cupbearer 3rd"); bred by Mr. Frost, Wherstead, Ipswich; sire, "Watton's Monarch;" dam, "Diamond" by "Son of Hero."

Agricultural Fillies—Three Years old.

Thomas Messinger, Beaden, Towcester, Northamptonshire: First Prize, 15*l.*, for "Flower," grey; bred by himself; sire, "Drayman;" dam, "Flower."

The Nottingham Corporation, Sewage Farm, Stoke Bardolph, Nottinghamshire: Second Prize, 10*l.*, for "Duchess," brown; bred by Mr. Isaac Barrett, Langar, Notts; sire, "Marshland Active."

Thomas Horrocks Miller, Singleton Park, Poulton-le-Fylde, Lancashire: Third Prize, 5*l.*, for "Bessie," bay; bred by Mr. W. Shaw, Thornton Raikes, Poulton-le-Fylde; sire, "Honest Tom" (1105); dam, "Flower," by "England's Glory" (732).

James Hawksworth, Barton Fields, Derby: the *Reserve Number* and *Highly Commended* for "Farmer," dapple brown; bred by himself; sire, "Lincoln;" dam, "Farmer," by "Young Lofty."

Clydesdale Fillies—Three Years old.

Lords Arthur and Lionel Cecil, of Orchardmains, Innerleithen, Peeblesshire, N.B.: First Prize, 15*l.*, for "Kelpie," bay; bred by Mr. J. McQueen, of Crofts, Dalbeattie, Kirkcudbright, N.B.; sire, "Young Lord Lyon" (994); dam, "Darling," of Crofts (340), by "Lorne" (499).

Sir Michael Robert Shaw Stewart, Bart., Ardgowan, Greenock, Renfrewshire: Second Prize, 10*l.*, for "Annot Lyle," bay; bred by Mr. James Ross, Titwood, Dunlop, Ayrshire; sire, "Young Lord Lyon" (994); dam, "Jean" (367), by "Lochfergus Champion" (449).

John Howatson, Fullwood, Stewarton, Ayrshire: Third Prize, 5*l.*, for "Young Maggie," brown; bred by himself; sire, "Young Lord Lyon;" dam, "Maggie."

Robert Loder, M.P., Whittlebury, Towcester, Northamptonshire: the *Reserve Number* to "Sonsie Queen," brown; bred by Mr. Baird, Urie, Falkirk, N.B.; sire, "Argyle" (15); dam, "Concetta," by "The Earl" (862

Agricultural Fillies—Two Years old.

The Hon. E. K. W. Coke, Longford Hall, Longford, Derby: First Prize, 15*l.*, for "Chocolate," brown; bred by Mr. Appleby, Snelston, Ashbourne, Derbyshire; sire, "Birkland" (133); dam by "Waxwork" (2306).

Thomas H. Miller, Singleton Park, Poulton-le-Fylde, Lancashire: Second Prize, 10*l.*, for "Meta," bay; bred by himself; sire, "Lincoln" (1350); dam, "Jewel," by "Honest Tom" (1105).

The Earl of Ellesmere, Worsley Hall, Lancashire: Third Prize, 5*l.*, for "Magic," brown; bred by Mr. Hawksworth, Barton Fields, Derby; sire, "Lincolnshire Lad 2nd" (1365); dam by "Hercules" (1019).

Lord Vernon, Sudbury Hall, Derby: the *Reserve Number* and *Highly Commended* for "Ruby," roan; bred by himself: sire, "British Wonder;" dam, "Trimmer" by "Young Lofty."

Clydesdale Fillies—Two Years old.

James McQueen, Crofts, Dalbeattie, Kirkcudbrightshire: First Prize, 15*l.*, for "Bessie Lee," bay, bred by himself; sire, "Pride of Clyde" (600); dam, "Brisk 2nd" (618), by "Pride of Galloway" (60).

Sir Michael Robert Shaw Stewart, Bart., Ardgowan, Greenock, Renfrewshire: Second Prize, 10*l.*, for "Leonora," bay; bred by Mr. J. Ross, Titwood, Dunlop, Ayrshire; sire, "Young Lord Lyon" (994); dam, "Jean," by "Lochfergus Champion" (449).

Marquis of Londonderry, Seaham Hall, Seaham Harbour, co. Durham: Third Prize, 5*l.*, brown; bred by himself; sire, "What Care I;" dam, "Nance" by "Hendrie's Farmer."

George Rodger, Arden House, Altrincham, Cheshire: the *Reserve Number* and *Highly Commended* for "Dawn of Mystery," brown; bred by himself; sire, "Prince Charlie" (629); dam, "Mystery," by "Craigie Lea" (204).

Suffolk Fillies—Two Years Old.

Sir Richard Wallace, Bart., K.C.B., M.P., Sudbourn Hall, Wickham Market: First Prize, 15*l.*, for "Jessie," chestnut; bred by himself; sire, "Prince Imperial" (1239); dam, "Brag."

Horace Wolton, Newbourn Hall, Woodbridge, Suffolk: Second Prize, 10*l.*, for "Miller's Maid," chestnut; bred by the late Mr. H. Betts, Rushmere, Ipswich; sire, "Royalty" (1339).

R. E. Lofft, Troston Hall, Bury St. Edmunds, Suffolk: the *Reserve Number* to "Betsy," chestnut; bred by Mr. Matthews, Pakenham, Suffolk: sire, "Lofft's Cupbearer."

*Agricultural Yearling Fillies.**

The Hon. E. K. W. Coke, Longford Hall: First Prize, 20*l.*, for "Chance," black; bred by Mr. W. Lawrence, Ask Farm, Prescot, Lancashire; sire, "Lincoln" (1350); dam, "Brock," by "Ploughboy" (1745).

Edward Holmes, Crow Trees Farm, Barton, Preston, Lancashire: Second Prize, 10*l.*, for "Miss Sykes," bay; bred by Messrs. Sykes, Hocking Hall, Whalley, Lancashire; sire, "What's Wanted" (2332); dam, "Bonny," by Edmondson's "England's Glory."

The Nottingham Corporation, Sewage Farm, Stoke Bardolph, Notts: the *Reserve Number* and *Highly Commended* for "Daisy," roan; bred by Mr. C. E. Winterton, Chatterson, Derby; sire, "Waxwork" (2306); dam by "Crown Prince" (558).

Hunter Mares and Foals.

William Wright, Wollaton, Nottingham: First Prize, 20*l.*, for "Rosamond," chestnut, 10 years-old (foal by "Silvester"); bred by Mr. Spencer, Pickley Lodge, Northamptonshire; sire, "Dalesman;" dam by "Catesby."

Russell Swanwick, Royal Agricultural College Farm, Cirencester, Gloucestershire: Second Prize, 10*l.*, for "Currer Bell," chestnut, 7 years-old (foal by "Blue Gown"); bred by himself; sire, "See-Saw;" dam, "Jane Eyre," by "Stockwell."

Hackney Mares and Foals, above 14 *hands* 2 *inches and not exceeding* 15 *hands* 2 *inches.*

Thomas H. Miller, Singleton Park, Poulton-le-Fylde, Lancashire: First Prize, 15*l.*, for "Belle," bay, aged (foal by "Denmark"); breeder unknown.

John Burton Burrows, Thurgarton Priory, Southwell, Notts: Second Prize, 10*l.*, for "Lady Grange," bay, 8 years-old (foal by "Young Perfection"); breeder unknown.

Pony Mares and Foals, above 13 *hands* 2 *inches and not exceeding* 14 *hands* 2 *inches.*

Joseph Aldred Milner, Gamston, Ratcliffe-on-Trent, Nottinghamshire: First Prize, 15*l.*, for "Cropwell," chestnut, 12 years-old (foal by "Little Gem"); bred by Mr. Barlow, Cotgrave, Ratcliffe-on-Trent; sire, "Jack Horner."

The Duke of Hamilton and Brandon, K.T., Easton Park, Wickham Market, Suffolk: Second Prize, 10*l.*, for "The French Mare," bay, aged (foal by "Prickwillow"); breeder unknown.

*Agricultural Yearling Entire Colts.**

The Earl of Ellesmere, Worsley Hall, Lancashire: First Prize, 20*l.*, for

his bay; bred by Mr. Potter, Lockington Grounds, Derby; sire, "What's Wanted" (2332); dam by "Samson" (1947).

ROBERT HORSLEY, Ashill, Watton, Norfolk: SECOND PRIZE, 10*l.*, for "Naughty Tom," bay; bred by Mr. Charles Collins, Cottenham, Cambs; sire, "Major" (1470); dam, "Diamond," by "King of the Fens" (1237).

JOSEPH MORTON, Stow Bardolph, Downham Market, Norfolk: the *Reserve Number* to "Bardolph Wonder," bay; bred by himself; sire, "Wonder of the West" (2371); dam, "Depper," by "Emperor" (692).

*Pairs of Agricultural Mares.**

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: FIRST PRIZE, 20*l.*, for "Black Diamond," black, 7 years-old; bred by Mr. Lambourne, Herdwick, Buckinghamshire; sire, "Conqueror" (544); dam by "Thumper" (2129); and "Bonny," grey, 7 years-old; bred by Mr. John Hollingworth, Weston-on-Trent, Derbyshire; sire, "Warwick" (2306); dam by "Uncle Tom" (2201).

THE DUKE OF WESTMINSTER, K.G., of Eaton, Chester: the *Reserve Number* to "Lady Whitelock," roan, 4 years-old; bred by Mr. James Fairclough, Rawcliffe, Lancashire; sire, "What's Wanted" (2332); dam by "Master of Arts" (1500): and "Duchess," roan, 4 years-old; bred by Mr. O. S. Macer, Norfolk; sire, "Duke."

*Pairs of Agricultural Geldings.**

ROBERT RATCLIFF, Newton Park, Burton-on-Trent: FIRST PRIZE, 20*l.*, for "Sampson," bay, 5 years-old; bred by Mr. J. Lee, Newton Solney; sire, "William the Conqueror;" dam, "Mettle": and "Stout," bay, 6 years-old; bred by Mr. R. Marbrow, Repton, Burton-on-Trent; sire, "William the Conqueror;" dam, "Rose."

*Agricultural Geldings—Three Years old.**

PHILIP STORER, New House Farm, Mickleover, Derby: FIRST PRIZE, 20*l.*, for "Captain," chestnut; bred by himself; sire, "Lincoln;" dam, "Trimmer" by "Champion."

GEORGE ARMSTRONG, Kirkland, Wigton, Cumberland: SECOND PRIZE, 10*l.*, for "Tom," bay; bred by Mrs. Barns, Green Rigg, Wigton, Cumberland; sire, "Simon Pure."

THOMAS H. MILLER, Singleton Park, Poulton-le-Fylde, Lancashire: the *Reserve Number* to "Marquis," bay; bred by himself; sire, "Dr. Gully" (676); dam, "Princess," by "Honest Tom" (1105).

*Agricultural Geldings—Two Years old.**

HENRY THOMPSON, Thornfield House, Chilwell, Nottinghamshire: FIRST PRIZE, 20*l.*, for "Prince," bay; bred by himself; sire, "William the Conqueror" (2343); dam, "Mettle," by "Uncle Tom" (2201): and SECOND PRIZE, 10*l.*, for "Major," bay; bred by himself; sire, "William the Conqueror" (2343); dam, "Brisk" by "Lincolnshire Lad" (1196).

ROBERT WILKINSON CRAWSHAW, The Hagge, Chesterfield, Derbyshire: the *Reserve Number* to "Don Quixote," black; bred by himself; sire, "Don Carlos" (2416); dam, "Daisy," by "Warwick" (2253).

*Hunter Mares or Geldings—Five Years old and upwards—up to 15 stone.**

JACOB STORDY, Wiggington, Tamworth, Staffordshire: FIRST PRIZE, 20*l.*, for "Sir Colin," chestnut gelding, 6 years-old; breeder unknown.

LE GENDRE NICHOLAS STARKIE, Huntroyde, Burnley, Lancashire: SECOND PRIZE, 10*l.*, for "Slingsby," bay gelding, 6 years-old; breeder unknown; sire, "Baron Cavendish;" dam by "Van Galen:" and the *Reserve Number* and *Highly Commended* for "Supervisor," bay gelding, 5 years-old; bred by Mr. J. W. J. Patterson, Terrona, Langholm, N.B.; sire, "Promised Land;" dam, "Countess of Croix," by "Scrivington."

*Hunter Mares or Geldings—Five Years old and upwards—up to 12 stone.**

JOHN BLENCOWE COOKSON, Meldon Park, Morpeth, Northumberland: FIRST PRIZE, 20*l.*, for "Old Boy," black gelding, 11 years-old; breeder unknown; sire, "Champagne."

HENRY FORD, Southernhay, Leamington, Warwickshire: SECOND PRIZE, 10*l.*, for "Pioneer," grey gelding, 5 years-old; breeder unknown; sire, "Dan O'Connor;" dam by "Victor."

JACOB STORDY, Wiggington, Tamworth: the *Reserve Number* and *Highly Commended* for "Trumpeter," chestnut gelding, 5 years-old; breeder unknown.

*Hunter Mares or Geldings—Four Years old—up to not less than 12 stone.**

COLONEL FREDERICK BARLOW, Hasketon, Woodbridge, Suffolk: FIRST PRIZE, 20*l.*, for "Floating Feather," chestnut mare; bred by Mr. Garnett, Williamston, Kells, Ireland; sire, "Uncas;" dam, "Petrel," by "General Peel."

CAPT. E. N. HEYGATE, R.E., Buckland, Leominster, Herefordshire: SECOND PRIZE, 10*l.*, for "Goldfinch," chestnut mare; breeder unknown; sire, "Lord Hastings;" dam by "Sir Hercules."

*Hunter Mares or Geldings—Three Years old.**

WILLIAM COATES JORDISON, The Spa, Thirsk, Yorkshire: FIRST PRIZE, 20*l.*, for "Novelty," black gelding; bred by himself; sire, "Duc de Beaufort;" dam by "Old Abonethia."

RICHARD HAWKRIDGE, 2, South Crescent, Ripon, Yorkshire: THIRD PRIZE, 10*l.*, for "Newby," black gelding; bred by himself; sire, "Duc de Beaufort;" dam, "Fanny," by "Despatch."

JOHN LETT, Scampston, York: the *Reserve Number* to "Lothair," chestnut gelding; bred by Mr. F. C. Lett, Foston, York; sire, "Meteor;" dam by "Hercules."

*Hackney Mares or Geldings, above 14·2 and not exceeding 15·1 hands, up to 15 stone.**

CHRISTOPHER W. WILSON, Rigmaden Park, Carnforth: FIRST PRIZE, 20*l.*, for "King Charles 3rd," chestnut gelding, 6 years-old; bred by Mr. J. Crompton, Burton Agnes, Yorkshire; sire, "Denmark;" dam by "St.

Giles": and SECOND PRIZE, 10*l.*, for "Pride of the North," chestnut mare, 4 years-old; breeder unknown; sire, "Star of the East."

MARMADUKE WRAY, Beverley, Yorkshire: the *Reserve Number* to "Sir George," brown gelding, 4 years-old; bred by Mr. J. Crathorne, Grove-hill, Beverley, Yorkshire; sire, "Brown Fireaway;" dam by "Achilles."

Hackney Mares or Geldings, above 14 *and not exceeding* 14·2 *hands, up to* 12 *stone.**

JOHN ROBINSON, Cleveland House, Coltman Street, Hull: FIRST PRIZE, 20*l.*, for "Lady Heseltine," chestnut mare, 5 years-old; bred by Mr. J. P. Crumpton, Burton Agnes, Yorks; sire, "Denmark;" dam, "St. Giles," by "Tom Thumb."

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: SECOND PRIZE, 10*l.*, for "Bosco," black gelding, aged; breeder unknown.

JOHN BURTON BARROW, Thurgarton Priory, Southwell, Nottinghamshire: the *Reserve Number* to "Lord Beaconsfield," brown gelding, 7 years-old; breeder unknown; sire, "Young Prickwillow;" dam by "Vandieman."

Hackney Mares or Geldings, above 13 *and not exceeding* 14 *hands.**

JOHN ROBINSON, Cleveland House, Coltman Street, Hull: FIRST PRIZE, 10*l.*, for "Lord Silvertail," roan gelding, 6 years-old; bred by Mr. Stubbs, York; sire, "Denmark."

JOHN COWLEY, Kilsby Grange, Rugby: SECOND PRIZE, 5*l.*, for "Prince," bay gelding, 8 years-old; breeder unknown.

JOHN PUGH, 26, St. Mary's Road, Garstang, Lancashire: the *Reserve Number* to "Miss Wilson," brown mare, 4 years-old; bred by Mr. C. W. Wilson, High Park, Kendal, Westmoreland; sire, "Sir George."

Pony Mares or Geldings, not exceeding 13 *hands.*

THOMAS HIRST THWAITES, Heaton, Bradford, Yorkshire: FIRST PRIZE, 10*l.*, for "Fashion," black gelding, 6 years-old; breeder unknown.

WILLIAM CLOSE, Poplar House, Colly Weston, Stamford: SECOND PRIZE, 5*l.*, for "The Nigger," black gelding, 5 years-old; breeder unknown.

JOSEPH CLEMENTSON, Pringle House, Skelton, Penrith, Cumberland: the *Reserve Number* to "Captain," bay gelding, 5 years-old; bred by Mr. G. Nelson, Dale Head, Martindale, Westmoreland; sire, "Stainmore Hero;" dam, "Nelly."

CATTLE.

Shorthorn Bulls above Three Years old.

THOMAS WILLIS, Jun., of Manor House, Carperby, Bedale, Yorkshire: FIRST PRIZE, 20*l.*, and the CHAMPION PRIZE of 30*l.*, † for "Vice-Admiral" (39,257), roan, 4 years, 10 months, 1 week, 5 days-old; bred by

† Given by the Shorthorn Society.

himself; sire, "Admiral Windsor" (32,912); dam, "Windsor's Hyacinth," by "Windsor's Prince" (32,164); g. d., "Camelia Windsor," by "Windsor Fitz-Windsor" (25,458); gr. g. d., "Camelia," by "Royal Alfred" (18,748); gr. g. g. d., "Mayflower," by "Knight of the Garter" (13,124).

The Marquis of Exeter, Burghley House, Stamford: Second Prize, 10*l.*, for "Telemachus 9th" (35,727), roan, 7 years, 6 months, 3 weeks, 6 days-old; bred by himself; sire, "Telemachus" (27,603); dam, "Seagull," by "Nestor" (24,648); g. d., "Petrel," by "Fourth Duke of Thorndale" (17,750); gr. g. d., "Sandpiper" by "The Briar" (15,376); gr. g. g. d., "Water Wagtail" by "Francisco" (12,893).

William Handley, of Green Head, Milnthorpe, Westmoreland: Third Prize, 5*l.*, for "Master Harbinger" (40,324), roan, 3 years, 7 months, 1 week, 6 days-old; bred by himself; sire, "Alfred the Great" (36,121); dam, "Earl's Flora," by "Earl of Eglinton" (23,832); g. d., "Flora Cobham," by "Marquis of Cobham" (22,299); gr. g. d., "Flower of Fitz-Clarence," by "Alfred Fitz-Clarence" (19,215); gr. g. g. d., "Miss Nicety," by "Veteran" (13,941).

James Nicholson, Murton, Berwick-upon-Tweed: the *Reserve Number* and *Highly Commended* for "Harold" (41,671), white, 3 years, 3 months, 1 week, 6 days-old; bred by Mr. John Angus, Bearl, Stocksfield-upon-Tyne; sire, "Hawthorn" (36,751); dam, "Bright Snowdrop," by "Roan Chief" (27,294); g. d., "Snowdrop," by "Brigade Major" (21,312); gr. g. d., "Lily," by "Lord Albert" (20,143); gr. g. g. d., "Blossom," by "Frederick" (14,571).

Shorthorn Bulls above Two and not exceeding Three Years old.

John Outhwaite, Bainesse, Catterick, Yorkshire: First Prize, 20*l.*, for "Lord Zetland," roan, 2 years, 2 months, 2 weeks, 5 days-old; bred by the Earl of Zetland, Aske Hall, Richmond, Yorkshire; sire, "Royal Windsor" (29,890); dam, "Florella," by "George Peabody" (28,710), g. d. "Floss," by "Windsor Augustus" (19,157); gr. g. d., "Flirt," by "Cobham" (14287); gr. g. g. d., "Wood Nymph," by "Ravensworth" (10681).

Robert Thompson, Inglewood Bank, Penrith, Cumberland: Second Prize, 10*l.*, for "Beau Benedict" (42,769); roan, 2 years, 4 months, 4 weeks, 1 day-old; bred by Mr. W. Linton, Sheriff Hutton, York; sire, "Paul Potter" (38,854); dam, "Home Beauty," by "Mountain Chief" (20,383); g. d. "Hand-Maid," by "May-Day" (20,323); gr. g. d. "White Rose," by "Magnus Troil" (14,880); gr. g. g. d., "Miss Henderson," by "Magnus Troil" (14,880).

Arthur Pemberton, Heywood-Lonsdale, of Gredington, Whitchurch, Salop: Third Prize, 5*l.*, for "Oxford, Duke of Killhow 2nd" (43,720); roan, 2 years, 4 months, 3 weeks, 4 days-old; bred by Mr. S. Porter Foster, Killhow, Mealsgate, Carlisle; sire, "Duke of Ormskirk" (36,526); dam, "Grand Duchess of Oxford 18th," by "Baron Oxford 4th" (25,580); g. d., "Grand Duchess of Oxford 11th," by "Grand Duke 10th" (21,848); gr. g. d. "Grand Duchess of Oxford 5th," by "Priam" (18,567); gr. g. g. d., "Countess of Oxford," by "Earl of Warwick" (11,412).

Francis John Savile Foljambe, M.P., Osberton Hall, Worksop, Notts: *Reserve Number* and *Highly Commended* for "Juniper," red and little white, 2 years, 6 months, 1 week, 4 days-old; bred by himself; sire, "Titan" (35,805); "June Rose," by "Cambridge Duke 4th" (25,706);

g. d., "Clematis," by "Sir John" (12,084); gr. g. d., "Clementina," by "Clementi" (3399); gr. g. g. d., "Farewell," by "Young Matchem" (4422).

Shorthorn Yearling Bulls, above One and not exceeding Two Years old.

ARTHUR GARFIT, Scothern, Lincoln, FIRST PRIZE, 20*l.*, for "Orange" (43,709), roan, 1 year, 7 months, 2 weeks, 4 days-old; bred by himself; sire, "Scothern Butterfly 2nd" (42,364); dam, "Orange Lass," by "Grand Duke 24th" (34,064); g. d., "Orange Girl," by "Grand Duke 19th" (28,746); gr. g. d., "Orange Leaf," by "Grand Duke 7th" (19,877); gr. g. g. d., "Orange Fruit," by "First Fruits" (16,048).

SIR WILLIAM CAYLEY WORSLEY, Bart., Hovingham, York: SECOND PRIZE, 10*l.*, for "Hovingham" (43,363), white, 1 year, 8 months, 3 weeks, 3 days-old; bred by himself; sire, "Sir Arthur Ingram" (32,490); dam, "Irwin's Star," by "Lord Irwin" (29,123); g. d., "Louise," by "White Windsor" (27,803); gr. g. d., "Mushroom," by "Earl of Windsor" (17,788); gr. g. g. d., "Beauty 2nd," by "Magnus Troil" (14,880).

WILLIAM HENRY WAKEFIELD, Sedgwick, Kendal, Westmoreland: THIRD PRIZE, 5*l.*, for "Baron Sedgwick," roan, 1 year, 5 months, 1 day-old; bred by himself; sire, "Baron Barrington 4th" (33,006); dam, "Well Heads Rose 2nd," by "Sir Arthur Windsor" (35,541); g. d., "Well Heads Rose," by "Dunrobin" (28,486); gr. g. d., "Rosebud 2nd," by "Albert Victor" (23293); gr. g. g. d., "Rosebud 1st," by "Squire Stuart" (20,891).

WILLIAM HANDLEY, Green Head, Milnthorpe, Westmoreland: the *Reserve Number* and *Highly Commended* for "Master Belville," roan, 1 year, 3 months, 3 weeks, 5 days-old; bred by himself; sire, "Master Harbinger" (40,324); dam, "Belle," by "Sir Arthur Windsor" (35,541); g. d., "Tulip," by "Prince Arthur" (29,597); gr. g. d, by "Sir Walter Trevelyan" (25,179); gr. g. g. d., by "General Garibaldi" (21,813).

Shorthorn Bull Calves, above Six and not exceeding Twelve Months old.

FRANCIS JOHN SAVILE FOLJAMBE, M.P., Osberton Hall, Worksop, Notts: FIRST PRIZE, 10*l.*, for "Andra del Sarto," roan, 10 months, 2 weeks, 1 day-old; bred by himself; sire, "Sir Andrew" (42,387); dam, "Sweetheart 32nd," by "Sweet Pea" (35,708); g. d., "Sweetheart 29th," by "Knight of the Bath" (26,546); gr. g. d., "Sweetheart 28th," by "Count Leinster" (23638); gr. g. g. d., "Sweetheart 11th," by "The Baron" (13,833).

SAMUEL THOMAS TREGASKIS, St. Issey, Cornwall: SECOND PRIZE, 5*l.*, for "Derby," red and little white, 10 months, 3 days-old; bred by himself; sire, "Model" (34,861); dam, "Fidelity," by "Red Cross Knight" (35,218); g. d., "Sweet One," by "Etoile du Nord" (21,710); gr. g. d., "Ladye-Love," by "Frank" (17,874); gr. g. g. d., "Fancy," by "Lord Barrington 1st" (13,170).

JOHN ALLAN ROLLS, M.P., the Hendre, Monmouth: the *Reserve Number* and *Highly Commended* for "Brian Boru," roan, 11 months, 2 weeks, 5 days-old; bred by himself; sire, '"Prince of Brailes" (42,193); dam, "Towneley Daisy," by "Grand Duke of Clarence" (28,750); g. d., "Rosalie 2nd," by "Towneley Wild Eyes" (27,674); gr. g. d., "Rosalie," by the "Bully" (23,019); gr. g. g. d., "Dulcinea," by "Lord Raglan" (13,222).

Shorthorn Cows, in-milk or in-calf, above Three Years old.

BENJAMIN ST. JOHN ACKERS, Prinknash Park, Painswick, Gloucestershire: FIRST PRIZE, 20*l.*,† for "Lady Carew 3rd," roan, 4 years, 8 months, 3 weeks, 5 days-old; in-milk; bred by himself; sire, "County Member" (28,268); dam, "Lady Jane," by "Baron Killerby" (23,364); g. d., "Miracle," by "Prince James" (20,554); gr. g. d., "Heather Bell," by "Hero" (18,055); gr. g. g. d., "Fanny," by "Ruben" (5027).

THE DUKE OF NORTHUMBERLAND, Alnwick Castle, Northumberland: SECOND PRIZE, 10*l.*, for "Lady Jane," roan, 4 years, 9 months, 2 weeks-old; in-milk; bred by himself; sire, "Fitz-Roland" (33,936); dam, "Janet," by "Mayor of Windsor" (31,897); g. d., "Young Dairymaid," by "Foxton" (23,979); gr. g. d., "Dairymaid," by "Melsomby" (18,380); gr. g. g. d., "Young Jessy," by "George 3rd" (16,147).

TEASDALE H. HUTCHINSON, Manor House, Catterick, Yorkshire: THIRD PRIZE, 5*l.*, for "Gainful," roan, 3 years, 8 months, 1 week, 2 days-old; in-milk and in-calf; bred by himself; sire, "King Alfonso" (36,832); dam, "Grateful," by "M. C." (31,898); g. d., "Gerty 3rd," by "Knight of the Shire" (26,552); gr. g. d., "Gerty," by "Vain Hope" (23,102); gr. g. g. d., "Garland," by "Grand Master" (24,078).

THE EARL OF TANKERVILLE, Chillingham Castle, Alnwick, Northumberland: the *Reserve Number* and *Highly Commended* for "Gaiety 3rd," roan, 6 years, 3 days-old; in-milk; bred by Mr. George Angus, of Broomley, Stocksfield-on-Tyne; sire, "Ben Brace" (30,524); dam, "Gaiety," by "Merry Monarch" (22,349); g. d., "Rachel," by "Monarch" (18,412); gr. g. d., "Young Matchless," by "Duke of Tyne" (12,773); gr. g. g. d., "Matchless," by "Young Hector" (7074).

Shorthorn Heifers, in-milk or in-calf above Two and not exceeding Three Years old.

TEASDALE H. HUTCHINSON, Manor House, Catterick, Yorkshire: FIRST PRIZE, 20*l.*, and the CHAMPION PRIZE of 30*l.*,† for "Gratia," roan, 2 years, 8 months, 3 weeks, 3 days-old; in-calf; bred by himself; sire, "Pluto" (35,050); dam, "Gratification," by "M.C." (31,898; g. d., "Gerty 3rd," by "Knight of the Shire" (26,552); gr. g. d., "Gerty," by "Vain Hope" (23,102); gr. g. g. d., "Garland," by "Grand Master" (24,078).

LORD FITZHARDINGE, Berkeley Castle, Gloucestershire: SECOND PRIZE, 10*l.*, for "Lady Wild Eyes 15th," red and white, 2 years, 10 months, 1 week old; in-milk; calved December 4th, 1880, and in-calf; bred by himself; sire, "Duke of Connaught" (33,604); dam, "Lady Wild Eyes 6th," by "Second Duke of Tregunter" (26,022); g. d., "Lady Wild Eyes 3rd," by "Cherry Grand Duke" (23,554); gr. g. d., "Lady Wild Eyes 2nd," by "Touchstone" (20,986); gr. g. g. d., "Lady Wild Eyes," by "Weathercock" (9815).

RICHARD STRATTON, the Duffryn, Newport, Mon.: THIRD PRIZE, 5*l.*, for "Mirthful," roan, 2 years, 11 months, 1 week, 3 days-old; in-calf; bred by himself; sire, "Lowlander" (37,022); dam, "Merry Lass," by "Brilliant" (28,084); g. d., "Merry Maid," by "James 1st" (24,202); gr. g. d., "Sportive 2nd," by "Eighth Duke of York" (33,808); gr. g. g. d., "Sportive," by "Windsor Castle" (21,118).

HENRY ARTHUR BRASSEY, Preston Hall, Aylesford, Kent: the *Reserve Number* and *Highly Commended*, for "Bracelet 29th," roan, 2 years, 6 months,

† Given by the Shorthorn Society.

3 weeks, 3 days-old; in-calf; bred by himself; sire, "Grand Duke 24th" (34,064); dam, "Bracelet 18th," by "Eighth Duke of Geneva" (28,390); g. d., "Bracelet 8th," by "Cherry Grand Duke" (22,554); gr. g. d., "Bracelet 2nd," by "Seventh Duke of York" (17,754); gr. g. g. d., "Bracelet," by "Second Duke of Bolton" (12,739).

Shorthorn Yearling Heifers, above One and not exceeding Two Years old.

Benjamin St. John Ackers, Prinknash Park, Painswick, Gloucestershire: First Prize, 20*l.*, for "Lady Georgina Newcomb," rich roan, 1 year, 11 months, 2 days-old; bred by himself; sire, "Lord Prinknash 2nd" (38,653); dam, "Lady Georgina Turbitt," by "County Member" (28,268); g. d., "Patience Heatherstone," by "British Crown" (21,322); gr. g. d., "Virtue," by "Valasco" (15,443); gr. g. g. d., "Lady Georgina," by "Knight Errant" (18,154).

David Pugh, Manoravon, Llandilo, Carmarthenshire: Second Prize, 10*l.*, for "Czarina Manoravon," roan, 1 year, 11 months, 6 days-old; bred by himself; sire, "Falmouth" (38,268); dam, "Czarina 11th," by "Sir Hildebrand" (29,993); g. d., "Czarina 9th," by "Falconer" (23,907); gr. g. d., "Czarina 5th," by "Earl of Elgin" (21,642); gr. g. g. d., "Zoe," by "Prince William" (20,607).

The Rev. Robert Bruce Kennard, Marnhull, Blandford, Dorset: Third Prize, 5*l.*, for "Blossom 5th," roan, 1 year, 11 months, 2 weeks, 1 day-old; bred by himself; sire, "Lord Fitzclarence 24th" (40,163); dam, "Blossom 3rd," by "Grand Duke of Oxford" (28,763); g. d., "Blossom," by "Earl of Darlington" (21,636); gr. g. d., "Belinda," by "Sir Roger" (16,991); gr. g. g. d., "Berrington Lass," by "Sir Walter 2nd" (10,834).

Arthur Garfit, Scothern, Lincoln: the *Reserve Number* and *Highly Commended* for "Blanche Rosette 5th," red roan, 1 year, 10 months, 2 weeks, 1 day-old; bred by himself; sire, "Grand Duke 25th" (34,065); dam, "Brilliant Rose 3rd," by "Second Wharfdale Oxford" (30,298); g. d., "Brilliant Rose," by "General Napier" (24,023); gr. g. d., "Brilliant," by "May Duke" (13,320); gr. g. g. d., "Blanche 3rd," by "Antinous" (12,401).

Shorthorn Heifer Calves, above Six and under Twelve Months old.

Colonel R. Nigel F. Kingscote, C.B., M.P., Kingscote, Wotton-under-Edge, Gloucestershire, First Prize, 10*l.*, for "Honey 82nd," roan, 11 months, 1 week, 6 days-old; bred by himself; sire, "Cowslip Boy" (38,051); dam, "Honey 61st," by "Duke of Hillhurst" (28,401); g. d., "Honey 33rd," by "Third Duke of Clarence" (23,727); gr. g. d., "Honeymoon," by "Caleb" (15,718); gr. g. g. d., "Honey Dew," by "Viceroy" (13.945).

The Executors of the late David McIntosh, Havering Park, Romford, Essex: Second Prize, 5*l.* for "Havering Gwynne 7th," red, 11 months, 6 days-old; bred by the late David McIntosh; sire, "Prince of Havering 4th" (42,202); dam, "Havering Gwynne," by "Duke of Havering" (33,664); g. d., "Catherine Gwynne," by "Second Duke of Wellington" (28,465); gr. g. d., "Frisky Gwynne," by "Thorndale Knightley" (23,065); gr. g. g. d., "Fanny Gwynne," by "Grand Duke 5th" (19,875).

William Hosken and Son, Loggan's Mill, Hayle, Cornwall: the *Reserve*

Number and *Highly Commended* for "Gertrude 5th," roan, 10 months, 1 week, 5 days-old; bred by themselves; sire, "Grand Duke 34th" (41,642); dam, "Gertrude 2nd," by "Duke of Oxford" (31,005); g. d., "Gertrude," by "Second Earl of Oxford" (23,844); gr. g. d., "Grateful," by "Thorndale Mason" (23,067); gr. g. g. d., "Graceful," by "Prince Frederick" (16,734).

Hereford Bulls, above Three Years old.

Philip Turner, The Leen, Pembridge, Herefordshire: First Prize, 20*l.*, for "Pirate," 3 years, 1 month, 3 weeks, 3 days-old; bred by himself; sire, "Corsair" (5271); dam, "Dorcas 4th," by "Leominster" (3910); g. d., "Dorcas 3rd," by "Bachelor" (2941); gr. g. d., "Dorcas 2nd," by "Bolingbroke" (1883).

William Taylor, Showle Court, Ledbury, Herefordshire: Second Prize, 10*l.*, for "Thoughtful" (5063), 6 years, 9 months, 6 days-old; bred by himself; sire, "Mercury" (3967); dam, "Young Beauty," by "Sir Francis" (3438); g. d., "Beauty," by "Holmer" (2043); gr. g. d., "Hazel," by "Tomboy" (1097).

Hereford Bulls, above Two and not exceeding Three Years old.

William Taylor, Showle Court, Ledbury, Herefordshire: First Prize, 20*l.*, for "Trafalgar" (6230), 2 years, 9 months, 3 weeks-old; bred by himself; sire, "Thoughtful" (5063); dam, "Monkton Beauty 3rd," by "Mercury" (3967); g. d., "Young Beauty," by "Sir Francis" (3438); gr. g. d., "Beauty," by "Holmer" (2043).

Frederick Platt, Barnby Manor, Newark, Notts: Second Prize, 10*l.*, for "Horace 4th," 2 years, 11 months, 2 weeks-old; bred by himself; sire, "Horace" (3877); dam, "Nutty," by "Cholstrey" (1918); g. d., "Nutty," by "Lord Clyde" (2084); gr. g. d., by "Son of Kohinoor" (825).

Hereford Yearling Bulls, above One and not exceeding Two Years old.

Rees Keene, Pencraig Vawr, Caerleon, Monmouthshire: First Prize, 20*l.*, for "Reward," 1 year, 5 months, 4 days-old; bred by himself; sire, "Lord Waterford" (6045); dam, "Fancy 5th," by "Tredegar" (4210); g. d., "Fancy," by "Sir Colin" (1727); gr. g. d., "Tidy," by "General Wyndham" (1590): and Second Prize, 10*l.*, for "Return," 1 year, 5 months old; bred by himself; sire, "Lord Waterford" (6045); dam, "Young Daisy," by "Prince Arthur" (2695); g. d., "Daisy," by "Pencraig" (2671); gr. g. d., "Sately," by "Prince Albert" (2168).

William Taylor, Showle Court, Ledbury, Herefordshire: the *Reserve Number* to "Thorold" (6226), 1 year, 7 months, 1 day-old; bred by himself; sire, "Thoughtful" (5063); dam, "Flighty," by the "Wolverhampton Boy" (4198); g. d., "Cherry," by "Tom Brown" (2828); gr. g. d., "Fancy," by "Twin Again" (2285).

Hereford Bull Calves, above Six and not exceeding Twelve Months old.

Thomas James Carwardine, Stockton Bury, Leominster, Herefordshire: First Prize, 10*l.*, for "Sir Bartle Frere," 11 months, 3 weeks, 6 days-old; bred by himself; sire, "Lord Wilton" (4740); dam, "Tiny," by "Longhorns" (4711); g. d., "Rosebud," by "De Cote" (3060); gr. g. d., "Stately," by "Heart of Oak" (2035): and Second Prize, 5*l.*, for

"Romeo," 11 months, 3 weeks, 6 days-old; bred by himself; sire, "Lord Wilton" (4740); dam, "Rosaline," by "De Cote" (3060); g. d., "Gentle," by "Heart of Oak" (2035); gr. g. d., "Theresa," by "Counsellor" (1939).

PHILIP TURNER, The Leen, Pembridge, Herefordshire: the *Reserve Number* and *Highly Commended* for "Rudolph," 11 months-old; bred by himself; sire, "Grove 3rd" (5051); dam, "Primrose 2nd," by "Spartan" (5009); g. d., "Primrose," by "Dauphin" (3058); gr. g. d., "Daffodil," by "Bachelor" (2941).

Hereford Cows, in-milk or in-calf, above Three Years old.

WILLIAM TAYLOR, Showle Court, Ledbury, Herefordshire: FIRST PRIZE, 15*l.*, for "Modesty," 5 years, 10 months, 2 weeks, 3 days-old; in-calf; bred by himself; sire, "Tredegar" (5077); dam, "Lovely," by "Tenant Farmer" (2806); g. d., "Browny," by "Twin" (2284).

THOMAS FENN, Stonebrook House, Downton Castle, Ludlow: SECOND PRIZE, 10*l.*, for "Maid of the Teme," 6 years-old; in-milk; bred by himself; sire, "Silver Chief" (4952); dam, "Lady of the Teme," by "Severus 2nd" (2747); g. d., "Victoria," by "Wilson" (4250); gr. g. d. by "Havelock" (1609).

THOMAS MYDDLETON, Beckjay, Aston-on-Clun, Salop: THIRD PRIZE, 5*l.*, for "Sally 3rd," 7 years, 9 months-old; in-milk and in-calf; bred by himself; sire, "Sultan" (4163); dam, "Sally 2nd," by "Son of David" (1204); g. d., "Sally," by "Plato" (2161); gr. g. d., "Sally," by "Jerry" (976).

THOMAS FENN, Stonebrook House, Downton Castle, Ludlow: the *Reserve Number* and *Highly Commended* for "Lady Cotmore 2nd," 3 years, 1 month, 3 weeks, 2 days-old; in-milk; bred by himself; sire, "Blakemere" (5227); dam, "Miss Cotmore," by "Cotmore" (4113); g. d., "Princess."

Hereford Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

FREDERICK PLATT, Barnby Manor, Newark, Notts: FIRST PRIZE, 15*l.*, for "Lady 3rd," 2 years, 9 months, 3 weeks, 4 days-old; in-calf; bred by himself; sire, "Horace" (3877); dam, "Lady 2nd," by "Orleton" (3293); g. d., "Lady," by "Cholstrey" (1918); gr. g. d., "Lady," by "Lord Clyde" (2084).

Hereford Yearling Heifers, above One and not exceeding Two Years old.

THOMAS JAMES CARWARDINE, Stockton, Bury, Leominster, Herefordshire: FIRST PRIZE, 15*l.*, for "Pretty Face," 1 year, 10 months, 3 weeks, 3 days-old; bred by himself; sire, "Anxiety" (5188); dam, "Pretty Maid," by "Longhorns" (4711); g. d., "Dahlia," by "De Cote" (3060); gr. g. d., "Fair Maid," by "Counsellor" (1939).

WILLIAM TAYLOR, Showle Court, Ledbury, Herefordshire: SECOND PRIZE, 10*l.*, for "Lorna Doone," 1 year, 11 months, 6 days-old; bred by himself; sire, "Horace" (3877); dam, "Monkton Beauty 3rd," by "Mercury" (3967); g. d., "Young Beauty," by "Sir Francis" (3438); gr. g. d., "Beauty," by "Holmer" (2043).

PHILIP TURNER, The Leen, Pembridge, Herefordshire: THIRD PRIZE, 5*l.*, for "Silvia," 1 year, 11 months, 2 days-old; bred by himself; sire, "Corsair"

(5271); dam, "Columbine," by "Silver Boy" (3419); g. d., "Exquisite," by "Provost" (4067); gr. g. d., "Norma," by "Bolingbroke" (1883).

THOMAS MYDDLETON, Beckjay, Aston-on-Clun, Salop: the *Reserve Number* and *Highly Commended* for "Miss Annie," 1 year, 11 months, 3 weeks-old; bred by himself; sire, "Hartington" (5358); dam, "Annie," by "Sultan" (4163); g. d., "Miss Nobble 'em," by "Nobleman" (2652); gr. g. d. by "Jerry" (976).

Hereford Heifer Calves, above Six and under Twelve Months old.

THOMAS JAMES CARWARDINE, Stockton Bury: FIRST PRIZE, 10*l.*, for "Venus," 11 months, 3 weeks, 1 day-old; bred by himself; sire, "Lord Wilton" (4740); dam, "Damsel," by "Longhorns" (4711); g. d., "Ethel," by "De Cote" (3060); gr. g. d., "Apology," by "Sir John 2nd" (3455): and SECOND PRIZE, 5*l.*, for "Henrietta,"10 months, 3 weeks, 4 days-old; bred by himself; sire, "Lord Wilton" (4740); dam, "Rosetta," by "Sir Frank" (2762); g. d., "Sunflower," by "Heart of Oak" (2035); gr. g. d., "Slipper," by "Counsellor" (1939).

THOMAS FENN, Stonebrook House, Downton Castle, Ludlow: the *Reserve Number* to "Downton Queen," 11 months, 4 days-old; bred by himself; sire, "Downton Boy" (5877); dam, "Lady Severus 2nd," by "Silver Chief" (4952); g. d., "Lady Severus," by "Severus 2nd" (2747); gr. g. d., "Princess," by "Tatnor" (1754).

Devon Bulls, above Three Years old.

VISCOUNT FALMOUTH, Tregothnan, Probus, Cornwall: FIRST PRIZE, 20*l.*, for "Sir Michael," 3 years, 10 months, 2 weeks-old; bred by himself; sire, "Sirloin" (1443); dam, "Water Lily" (5050), by "Jonquil" (1131); g. d., "Watercress" (4006), by "Sunflower" (937); gr. g. d., "Cheesewring" (2572A), by "Protector" (711).

ALFRED C. SKINNER, Pound Farm, Bishops Lydeard, Taunton: SECOND PRIZE, 10*l.*, for "Fancy's Robin," 3 years, 6 months, 1 week, 2 days-old; bred by himself; sire, "Master Robin" (1162); dam, "Fancy 3rd" (4478), by "Red Prince" (1432); g. d., "Fancy 1st" (4476).

VISCOUNT FALMOUTH, Tregothnan: the *Reserve Number* and *Highly Commended* for "Master Molesworth," 4 years, 11 months, 2 weeks, 3 days-old; bred by himself; sire, "Master Flitton" (1160); dam, "Christmas Rose" (3280), by "Sunflower" (937); g. d., "Rosa Bonheur" (3009), by "Corrector" (809); gr. g. d., "Picture 4th" (2224), by "Davy's Napoleon 3rd" (464).

Devon Bulls, above Two and not exceeding Three Years old.

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: FIRST PRIZE, 20*l.*, for "Sweet William," 2 year, 10 months, 1 week-old; bred by Viscount Portman, Bryanston, Blandford; sire, "Young Palmerston" (1251); dam, "Famous" (4450), by "Duke of Plymouth" (1080); g. d., "Famous."

MRS. LANGDON, Flitton Barton, North Molton, Devon: *Reserve Number* to "Jonquil 2nd," 2 years, 8 months, 4 weeks-old; bred by herself; sire, "Jonquil;" dam, "Actress 7th," by "Duke of Flitton 6th;" g. d., "Actress 3rd," by "Duke of Flitton 3rd;" gr. g. d., "Actress 1st," by "Palmerston."

Devon Yearling Bulls, above One and not exceeding Two Years old.

Mrs. Langdon, Flitton Barton, North Molton, Devon: First Prize, 20*l.*, for "Duke of Flitton 15th," 1 year, 8 months, 1 week, 2 days-old, bred by herself; sire, "Lord Bath;" dam, "Actress 7th" (3148), by "Duke of Flitton 6th" (1070); g. d. "Actress 3rd" (2749), by "Duke of Flitton 3rd" (826); gr. g. d. "Actress 1st" (1749), by "Palmerston" (476).

Viscount Falmouth, Tregothnan, Probus, Cornwall: Second Prize, 10*l.*, for "Banjo," 1 year, 9 months, 3 weeks, 3 days-old; bred by himself; sire, "The Only Jones" (1468); dam, "Reflection" (3880), by "Sunflower" (937); g. d., "Picture 4th" (2224), by "Davy's Napoleon 3rd" (464); gr. g. d., "Picture" (337): and the *Reserve Number* and *Highly Commended*, for "Plum Pudding," 1 year, 10 months, 1 day-old; bred by himself; sire, "Sirloin" (1443); dam, "Christmas Rose" (3280), by "Sunflower" (937); g. d., "Rosa Bonheur" (3009), by "Corrector" (809); gr. g. d., "Picture 4th" (2224), by "Davy's Napoleon 3rd" (464).

Devon Bull Calves, above Six and not exceeding Twelve Months old.

Mrs. Langdon, Flitton Barton, North Molton, Devon: First Prize, 10*l.*, for "Duke of Flitton 17th," 9 months, 2 days-old; bred by herself; sire, "Sir Bevys;" dam, "Actress 13th," by "Young Palmerston;" g. d., "Actress 2nd," by "Duke of Flitton 3rd;" gr. g. d., "Actress 1st," by "Palmerston."

William Rolles Fryer, Lytchett Minster, Poole, Dorset: Second Prize, 5*l.*, for "Nosegay," 11 months, 3 weeks, 1 day-old; bred by himself; sire, "Viceroy;" dam, "Neat" (3724), by "Prince Albert" (907); g. d., "Nigger."

Viscount Falmouth, Tregothnan, Probus, Cornwall: the *Reserve Number* to his 10 months, 4 weeks, 1 day-old; bred by himself; sire, "The Only Jones" (1468); dam, "Remembrance" (3882), by "Cinnamon" (1039); g. d., "Photograph" (3758), by "Sunflower" (937); gr. g. d., "Picture 4th" (2224), by "Davy's Napoleon 3rd" (464).

Devon Cows, in-milk or in-calf, above Three Years old.

Alfred C. Skinner, Pound Farm, Bishop's Lydeard, Taunton: First Prize, 15*l.*, for "Famous 2nd," 3 years, 8 months, 3 weeks, 3 days-old; in-milk and in-calf; bred by Mr. Walter Farthing, Stowey Court, Bridgwater; sire, "Master Willie" (1163); dam, "Famous" (4448), by "Son of Lord Quantock" (874); g. d., "Famous" (1965), by "Duke of Chester" (404); gr. g. d., "Famous" (1319), by "Sultan" (318).

Mrs. Langdon, Flitton Barton: Second Prize, 10*l.*, for "Temptress 8th," 5 years, 2 weeks, 2 days-old; in-milk and in-calf; bred by herself; sire, "Duke of Flitton 10th;" dam, "Temptress 5th," by "Duke of Flitton 5th;" g. d., "Temptress 2nd," by "Duke of Cornwall;" gr. g. d., "Gold Medal Temptress," by "Davy's Napoleon:" and the *Reserve Number* and *Highly Commended* for "Temptress 12th," 4 years, 4 days-old; in-milk and in-calf; bred by herself; sire, "Jonquil;" dam, "Temptress 2nd," by "Duke of Cornwall" (820); g. d., "Gold Medal Temptress," by "Davy's Napoleon;" gr. g. d., "Pink."

Devon Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

WILLIAM ROLLES FRYER, Lytchett Minster: FIRST PRIZE, 15*l.*, for "Fuchsia," 2 years, 4 months, 1 week-old; in-calf; bred by Viscount Portman, Bryanston, Blandford; sire, "Flower's Duke" (1341); dam, "Young Fancy," by "Triumph 2nd" (1475); gr. g. d., "Fancy:" and the *Reserve Number* to "Hyacinth," 2 years, 10 months, 2 weeks, 1 day-old; in-calf; bred by himself; sire, "Sultan" (1455); dam, "Balsam" (4056), by "Emperor" (1096); g. d., "Blanche" (3215), by "Prince Albert" (907); gr. g. d., "Beauty."

Devon Yearling Heifers, above One and not exceeding Two Years Old.

WILLIAM ROLLES FRYER, Lytchett Minster, Poole, Dorset: FIRST PRIZE, 15*l.*, for "Canterbury Belle," 1 year, 10 months, 4 weeks-old; bred by himself; sire, "The Czar," (1461); dam, "Cherry" (4208), by "Emperor" (1096); g. d., "Cherry;" gr. g. d., "Champion."

MRS. LANGDON, Flitton Barton, North Molton, Devon: SECOND PRIZE, 10*l.*, for "Rosebud," 1 year, 1 month, 1 week-old; bred by herself; sire, "Sir Bevys;" dam, "Temptress 4th," by "Duke of Flitton 4th;" g. d., "Gold Medal Temptress," by "Davy's Napoleon."

WILLIAM ROLLES FRYER, Lytchett Minster: the *Reserve Number* and *Highly Commended* for "Phlox," 1 year, 4 months, 3 weeks, 6 days-old; bred by Viscount Portman, Bryanston, Blandford; sire, "Flower's Duke" (1341); dam, "Young Fancy," by "Triumph 2nd" (1475); g. d., "Fancy."

Devon Heifer Calves, above Six and under Twelve Months old.

WILLIAM ROLLES FRYER, Lytchett Minster: FIRST PRIZE, 10*l.*, for "Picotee," 11 months, 2 weeks, 2 days-old; bred by himself; sire, "Viceroy;" dam, "Queen Anne" (4887), by "Duke of Plymouth" (1080); g. d., "Queen" (4886).

Sussex Bulls, Two Years old and upwards.

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: FIRST PRIZE, 20*l.*, for "Goldsmith" (391), 3 years, 10 months-old; bred by the late Mr. G. Smith, Paddockhurst, Crawley, Sussex; sire, "Young Hartley" (444); dam, "Young Golding," by "Lion."

JAMES STEWART HODGSON, Lythe Hill, Haslemere, Surrey: SECOND PRIZE, 10*l.*, for "Oxford" (304), red, 3 years, 9 months, 2 weeks, 4 days-old; bred by Mr. Alfred Agate, Broomhall, Horsham; sire, "Berry" (259); dam, "Honesty 2nd" (1618), by "Alfred 2nd" (177); g. d., "Honesty" (1333), by "Grand Duke" (183); gr. g. d., "Honesty" (443), by "Unicorn" (15).

JOHN and ALFRED HEASMAN, Angmering, Worthing, Sussex: the *Reserve Number* and *Highly Commended* for "Royal Kilburn" (401), red, 2 years, 10 months, 3 weeks, 2 days-old; bred by themselves; sire, "Hereford" (263); dam, "Cherry" (1244), by "William" (139); g. d., "Leicester" (1120), by "Prince Arthur" (129); gr. g. d., "Plymouth" (1024), by "The Duke" (97).

Sussex Yearling Bulls, above One and not exceeding Two Years old.

THOMAS A. VICKRESS, Hill House, Slinfold, Horsham, Sussex: FIRST PRIZE,

15*l.*, for "Lord Stanley," red, 1 year, 9 months, 4 days-old; bred by himself; sire, "Berry" (259); dam, "Shelly" (1819).

JAMES STEWART HODGSON, Lythe Hill, Haslemere, Surrey: SECOND PRIZE, 10*l.*, for "Young Oxford" (445), red, 1 year, 7 months, 6 days-old; bred by himself; sire, "Oxford" (304); dam, "Pitcher 3rd" (2105), by "Berry" (259); g. d. "Pitcher 2nd" (1545), by "Grand Duke" (183); gr. g. d., "Pitcher" (1434).

JOHN and ALFRED HEASMAN, of Angmering, Worthing, Sussex: the *Reserve Number* and *Highly Commended* for "Sir Bevys," red, 1 year, 8 months, 3 weeks, 3 days-old; bred by themselves; sire, "Calcetto" (273); dam, "Sandgate" (1661).

Sussex Cows, in-milk or in-calf, above Three Years old.

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning, Sussex: FIRST PRIZE, 15*l.*, for "Dorset 2nd" (1993), red, 5 years, 11 months, 1 week, 4 days-old; in-calf; bred by themselves; sire, "Dorchester" (325); dam, "Dorset" (1991), by "Young Westminster" (159).

JAMES STEWART HODGSON, Lythe Hill, Haslemere, Surrey; SECOND PRIZE, 10*l.*, for "Pitcher 3rd" (2105); red, 3 years, 11 months, 3 weeks, 2 days-old; in-milk; bred by Mr. A. Agate, Broomhall, Horsham, Sussex; sire, "Berry" (259); dam, "Pitcher 2nd" (1545), by "Grand Duke" (183); g. d., "Pitcher" (1434).

JOHN and ALFRED HEASMAN, Angmering, Worthing, Sussex: the *Reserve Number* and *Highly Commended* for "Famous," red, 3 years, 7 months, 3 weeks, 6 days-old; in-milk and in-calf; bred by themselves; sire, "Hereford" (263); dam, "Reeve."

Sussex Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

JAMES STEWART HODGSON, Lythe Hill, Haslemere, Surrey: FIRST PRIZE, 15*l.*, for "Crocus 2nd" (2349), red, 2 years, 9 months, 2 weeks, 1 day-old; in-calf; bred by Messrs. J. and A. Heasman, Angmering, Worthing; sire, "Hereford" (263); dam, "Crocus" (1692), by "Lord of Lorne" (207); g. d., "Cheerful."

EDWARD and ALFRED STANFORD, Eatons, Ashurst, Steyning: SECOND PRIZE, 10*l.*, for "Rosedew 3rd" (2289), red, 2 years, 10 months, 3 weeks-old; in-milk; bred by themselves; sire, "Clayton" (319); dam, "Rosedew 1st" (2129) by "Dorchester" (325); g. d., "Rosedew" (2128) by "Young Westminster" (159).

JOHN and ALFRED HEASMAN, Angmering, Worthing, Sussex: THIRD PRIZE, 5*l.*, for "Lady Carlisle" (2405), red, 2 years, 11 months-old; in-calf; bred by themselves; sire, "Hereford" (263); dam, "Snowdrop" (1727), by "Egerton;" g. d., "Leicester," by "Prince Arthur" (129).

Sussex Yearling Heifers, above One and not exceeding Two Years old.

JAMES STEWART HODGSON, Lythe Hill, Haslemere: FIRST PRIZE, 15*l.*, for "Laura 5th" (2412), red, 1 year, 8 months, 2 weeks-old; bred by himself; sire, "Oxford" (304); dam, "Laura 3rd" (2055), by "Little Tom;" g. d., "Laura 1st" (2053) by "Nottingham 1st;" gr. g. d., "Young Gentle."

JOHN and ALFRED HEASMAN, Angmering, Worthing: SECOND PRIZE, 10*l.*, for

their red, 1 year, 11 months, 3 weeks, 2 days-old; bred by themselves; sire, "Hereford" (263); dam, "Pride of Ham" (1436), by "Southampton" (155); g. d., "Cherry" (1244), by "Egerton": and the *Reserve Number* and *Highly Commended* for "Lady Worcester," red, 1 year, 9 months, 3 weeks, 4 days-old; bred by themselves; sire, "Hereford" (263); dam, "Snowdrop" (1727), by "Egerton."

Longhorn Bulls, Two Years old and Upwards.

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: FIRST PRIZE, 20*l.*, for "Earl of Temple," brindle and white, 6 years, 10 months, 2 weeks, 4 days-old; bred by himself; sire, "Conqueror 3rd;" dam, "Duchess," by "Boycott;" g. d., "Diadem," by "Tamworth;" gr. g. d., "Dolly."

SIR JOHN HARPUR CREWE, Bart., Calke Abbey, Derby: SECOND PRIZE, 10*l.*, for "Harlequin," brindle and white, 2 years, 5 months, 1 week, 1 day-old; bred by himself; sire, "The Abbot of Calke" (220); dam, "Gaudy," by "Tippoo" (232); g. d., "Sparkenhoe Lass," by "Emperor" (80); gr. g. d., "Old Spondon," by "Curzon" (43).

WILLIAM SMITH SHAW, Fradley Old Hall, Lichfield, Staffordshire: the *Reserve Number* to "Earl of Fradley 3rd," brindle and white, 4 years, 5 months, 2 weeks-old; bred by himself; sire, "Earl of Upton 7th" (76); dam, "Hagley," by "Curzon" (43); g. d., "Daisy" by "Sparkenhoe" (206); gr. g. d., "Old Daisy," by "Protection" (165).

Longhorn Bulls, above One and not exceeding Two Years old.

JOHN GERMAN, Ashby-de-la-Zouch, Leicestershire: FIRST PRIZE, 20*l.*, for "The Prior of Ashby," brindle and white, 1 year, 1 month, 3 weeks, 5 days-old; bred by himself; sire, "The Abbot of Calke;" dam, "Lady Huntingdon," by "Royal Duke of Upton;" g. d., by "Upton Hero."

WILLIAM PEYTON BURBERY, The Crofts, Stratford-on-Avon: SECOND PRIZE, 10*l.*, for "Corporal," red and white, 1 year, 8 months, 1 week, 4 days-old; bred by Mr. J. H. Burbery, Montague House, Kenilworth; sire, "The Captain" (223); dam, "Perfection," by "Blue Knight" (222); g. d., "Milkmaid," by "Samson 2nd" (193); gr. g. d., "Tulip," by "The Stranger" (228).

WILLIAM JOHN LEGH, M.P., Lyme Park, Disley, Stockport, Cheshire: the *Reserve Number* and *Highly Commended* for "Brutus," brindle and white, 1 year, 10 months, 2 weeks-old; bred by himself; sire, "Darnley" (49); dam, "Buttercup 2nd," by "The Stranger" (228); g. d., "Buttercup," by "Bosworth Sparkinhoe" (10); gr. g. d., "Rollright."

Longhorn Bull Calves, above Six and not exceeding Twelve Months old.

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: FIRST PRIZE, 10*l.*, for "Fairy Prince," brindle and white, 11 months, 3 weeks, 3 days-old; bred by himself; sire, "Earl of Temple;" dam, "Fairy," by "Wotton;" g. d., "Fanny," by "Conqueror;" gr. g. d., "Fickle," by "Boycott."

Longhorn Cows, in-calf or in milk.

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: FIRST PRIZE, 15*l.*, for "Lady Aston," red and white, 3 years, 11 months,

2 weeks, 1 day-old; in-milk; in-calf; bred by himself; sire, "Earl of Wigston;" dam, "Lady Arden 2nd," by "Twycross's Bull;" g. d., "Faithful," by "Old Messenger;" gr. g. d., "Weston Lady."

SAMUEL FORREST, The Chase, Kenilworth, Warwickshire: SECOND PRIZE, 10*l*., for "Walnut," brindle and white, 6 years, 4 months, 5 days-old; in-milk and in-calf; bred by himself; sire, "Crown Prince" (41); dam, "Sleepy," by "Borderer" (9): g. d., "Spot 1st," by "The Colonel" (224); gr. g. d., "Bluebell 1st."

MAJOR-GENERAL SIR FREDERICK FITZWYGRAM, Bart., Leigh Park, Havant, Hants: the *Reserve Number* and *Highly Commended* for "First Link," red and white, 3 years, 3 months, 1 week, 5 days-old; in-calf; bred by himself; sire, "Prince Victor;" dam, "Upton's Last Link Save One," by "Shakespeare" (196); g. d., "Lady Cake," by "Earl of Warwick" (77); gr. g. d., "Old Brindled Beauty," by "Sparkenhoe" (206).

Longhorn Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

MAJOR-GENERAL SIR F. FITZWYGRAM, Bart., Leigh Park, Havant: FIRST PRIZE, 15*l*., for "Rose Leigh," red, little white, 2 years, 5 months, 2 weeks, 5 days-old; in-calf; bred by himself; sire, "Fradley Baronet;" dam, "Tulip," by "Tippoo" (232).

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: SECOND PRIZE, 10*l*., for "Lady Mary 2nd," brindle and white, 2 years, 9 months, 3 weeks, 4 days-old; in-calf; bred by himself; sire, "Conqueror 3rd;" dam, "Lady Mary," by "Young Conqueror;" g. d., "Venus," by "Boycott;" gr. g. d., "Vanity."

SIR JOHN HARPUR CREWE, Bart., Calke Abbey, Derby: the *Reserve Number* and *Highly Commended* for "Tulip 19th," red and white, 2 years, 5 months, 4 weeks, 2 days-old; in-calf; bred by himself; sire, "Earl of Weston;" dam, "Tulip 10th," by "Earl of Upton 1st;" g. d., "Tulip 5th," by "Upton;" gr. g. d., "Tulip 4th," by "Sampson."

Yearling Heifers, above One and not exceeding Two Years old.

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe, Buckingham: FIRST PRIZE, 10*l*., for "Violet," brindle and white, 1 year, 11 months, 1 day-old; bred by himself; sire, "Conqueror 3rd;" dam, "Verbena," by "Conqueror;" g. d., "Veronica," by "Boycott;" gr. g. d., "Vesper": and SECOND PRIZE, 5*l*., for "Nancy," red and white, 1 year, 3 months, 3 weeks, 1 day-old; bred by himself; sire, "Earl of Temple;" dam, "Nelly," by "Wotton;" g. d., "Nettle," by "Constantine;" gr. g. d., "Nipple."

RICHARD HALL, of Thulston Grove, Derby: the *Reserve Number* to "Lady Walton," red and white, 1 year, 11 months, 1 week-old; bred by himself; sire, "Earl of Fradley 1st" (62); dam, "Fairmaid," by "Earl of Upton 6th."

Longhorn Heifer Calves, above Six and not exceeding Twelve Months old.

RICHARD HALL, Thulston Grove: FIRST PRIZE, 10*l*., for "Brindled Nell," brindle and white, 11 months, 3 weeks, 2 days-old; bred by himself; sire, "Baron Hardendale;" dam, "Brindled Nancy," by "Twycross" (239); g. d., "Myrtle;" gr. g. d., "Bramcote Rose."

THE DUKE OF BUCKINGHAM AND CHANDOS, Stowe: SECOND PRIZE, 5*l.*, for "Garland," brindle and white, 10 months, 2 weeks-old; bred by himself; sire, "Earl of Temple;" dam, "Graceful" by "Young Conqueror;" g. d., "Grace," by "Boycott;" gr. g. d., "Graceless": and the *Reserve Number* and *Highly Commended* for "Winnifred 3rd," red and white, 11 months, 3 weeks, 1 day-old; bred by himself; sire, "Earl of Temple;" dam, "Winnifred," by "Young Conqueror;" g. d., "Wildfire," by "Boycott;" gr. g. d., "Woodbine," by "Tamworth."

Jersey Bulls, above Two Years old.

WILLIAM ALEXANDER, Grasfort Farm, Gorey, Jersey: FIRST PRIZE, 20*l.*, for "Noble," dark grey, 2 years, 3 months, 1 week, 6 days-old; bred by himself.

THOMAS HORROCKS MILLER, Singleton Park, Poulton-le-Fylde, Lancashire: SECOND PRIZE, 10*l.*, for "Earl of Beaconsfield," silver-grey, 2 years, 7 months, 3 weeks-old; bred by Mr. W. H. Wakefield, Sedgwick, Kendal, Westmoreland; sire, "Gladstone 2nd;" dam, "Grisette," by "Yankee;" g. d., "Queen of the Valley."

THOMAS OATLEY BENNETT, Tolbury, Bruton, Somerset: THIRD PRIZE, 5*l.*, for "Tolbury Beauty," grey fawn, 2 years, 2 months, 1 week-old; bred by Mr. John Le Brocq, St. Clement's, Jersey; dam, "Lady Jane," by "Rufus;" g. d., "Butterfly."

JOHN CARDUS, Town Hill, West End, Southampton: the *Reserve Number* and *Highly Commended* for "Baron Lionel," silver-grey, 2 years, 4 weeks-old; bred by himself; sire, "Dairy King" (211); dam, "Bagotine," by "Welcome;" g. d., "Mignonne."

Jersey Bulls, not exceeding Two Years old.

F. LE BROCQ, Augerez, St. Peter's, Jersey: FIRST PRIZE, 15*l.*, for "Farmer's Joy," dark grey, 1 year, 4 months-old; bred by Mr. John Arthur, St. Mary's, Jersey; sire, "Farmer's Glory" (274); dam, "Victory" (1999).

WILLIAM ARKWRIGHT, Sutton Scarsdale, Chesterfield: SECOND PRIZE, 10*l.*, for "Lucifer," silver-grey, 1 year, 3 weeks, 1 day-old; bred by himself; sire, "Grey of the East" (383); dam, "Pandora."

GEORGE SIMPSON, Wray Park, Reigate, Surrey: THIRD PRIZE, 5*l.*, for "Queen's Messenger," grey fawn, 1 year, 2 months, 1 week, 1 day-old; bred by himself; sire, "Milkboy" (561); dam, "Queen Dora," by "Prime Minister" (664); g. d., "Queen," by "Marquis" (533); gr. g. d., "Beauty."

MRS. LEIGH, Luton Hoo Park, Luton, Bedfordshire: the *Reserve Number* and *Highly Commended* for her grey fawn, 1 year, 2 months, 4 days-old; bred by herself; sire, "Colonel;" dam, "Princess," by "Duke Humphrey."

Jersey Cows, in-milk or in-calf, above Three Years old.

WILLIAM ARKWRIGHT, Sutton Scarsdale, Chesterfield: FIRST PRIZE, 20*l.*, for "Lilian," silver-grey, 3 years, 3 months-old; in-calf; bred by Mr. Le Quesel, St. John's, Jersey; sire, "Virtumnus" (161); dam, "Buttercup."

GEORGE SIMPSON, Wray Park, Reigate: SECOND PRIZE, 10*l.*, for "Laura," silver-grey, 5 years, 6 months, 3 weeks-old; in-calf; bred by Mr. G.

e 2

Trachy, St. Brelades, Jersey; sire, "Grey Prince" (385); dam, "Actress."

JAMES ASHCROFT, Grange House, Oakhill Park, Old Swan, Liverpool: THIRD PRIZE, 5*l.*, for "Souris," silver-grey, 4 years, 2 months, 4 days-old; in-milk; bred by Mr. A. Le Heron, St. Helier's, Jersey; sire, "Apollo" (108); dam, "Brunette" (142).

JAMES BLYTH, Wood House, Stanstead, Essex: the *Reserve Number* and *Highly Commended* for "Sylvie 3rd," silver-grey, 3 years, 3 months, 1 week, 3 days-old; in-calf; bred by Mr. Le Brocq, Augerez, St. Peter's, Jersey; sire, "Jimmy;" dam, "Sylvie."

Jersey Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

GEORGE SIMPSON, Wray Park, Reigate: FIRST PRIZE, 15*l.*, for "Patricia," silver-grey, 2 years, 1 month, 4 weeks, 1 day-old; in-calf; bred by himself; sire, "Romeo" (760); dam, "Portia," by "Welcome 2nd" (937); g. d., "Fleurie" (859).

F. LE BROCQ, Augerez, St. Peter's, Jersey: SECOND PRIZE, 10*l.*, for "Daisy," grey fawn, 2 years, 4 months-old; in-milk; bred by Mr. John Godel, St. Laurence, Jersey.

JOHN CARDUS, Town Hill, West End, Southampton: THIRD PRIZE, 5*l.*, for "Elaine," silver-grey, 2 years, 3 months-old; in-milk; calved April 26th, 1881; bred by himself; sire, "Dairy King" (211); dam, "Elite," by "Grey Prince;" g. d., "Jeannette."

GEORGE SIMPSON, Wray Park: the *Reserve Number* and *Highly Commended* for "Lily of the Valley," grey fawn, 2 years, 10 months-old; in-calf; bred by Mr. P. Le Breton, St. Saviour's, Jersey; sire, "Governor" (369); dam, "Fleur-de-Lys" (1729).

Jersey Heifers, above One and not exceeding Two Years old.

GEORGE SIMPSON, Wray Park, Reigate: FIRST PRIZE, 10*l.*, for "Pandora 3rd," silver-grey, 1 year, 8 months, 1 week, 2 days-old; bred by himself; sire, "Farmer's Glory" (319); dam, "Pandora 2nd," by "Milord" (566); g. d., "Pandora" (1645).

JOHN CARDUS, Town Hill, West End, Southampton: SECOND PRIZE, 5*l.*, for "Coralie," silver-grey, 1 year, 2 months, 2 weeks, 2 days-old; bred by himself; sire, "Dairy King" (211); dam, "Bagotine," by "Welcome;" g. d., "Mignonne."

HERBERT ADDINGTON RIGG, Wykeham Lodge, Walton-on-Thames, Surrey: the *Reserve Number* and *Highly Commended* for "Rosabelle," fawn, 1 year, 9 months, 3 weeks-old; in-calf; bred by himself; sire, "Gipsy Lad" (359); dam, "Rosina;" g. d., "Flirt."

*Jersey Heifer Calves, above Six and not exceeding Twelve Months old.**

JOHN CARDUS, Town Hill: FIRST PRIZE, 10*l.*, for "Vixen," silver-grey, 11 months, 2 weeks, 2 days-old; bred by himself; sire, "Dairy King" (211); dam, "Velveteen," by "Grey Prince" (385); g. d., "Valentine" (734).

GEORGE SIMPSON, Wray Park: SECOND PRIZE, 5*l.*, for "Gulnare," grey, 11 months, 4 weeks-old; bred by himself; sire, "Milk Boy" (561); dam, "Gertrude," by "Noble 2nd" (591).

John Cardus, Town Hill: the *Reserve Number* and *Highly Commended* for "Goldylocks," silver-grey, 11 months, 1 week, 5 days-old; bred by himself; sire, "Bit o' Blue;" dam, "Alice," by "Dairy King" (211); g. d., "Agnes," by "Wellington" (938); gr. g. d., "Lydiate," by "Chandos" (169).

Guernsey Bulls, above One Year old.

John Richard Newberry, Hill Barton, Heavitree, Exeter: First Prize, 15*l.*, for "Duke of Devon," yellow and white, 1 year, 7 months-old; bred by himself; dam, "Pretty Maid."

James James, Les Vauxbelets, Guernsey: Second Prize, 10*l.*, for "Squire of Les Vauxbelets," red and white, 3 years, 7 months, 4 weeks, 1 day-old; bred by himself; sire, "Royal Duke;" dam, "Valentine 1st of Les Vauxbelets;" g. d., "Rosy."

W. Wingate Saul, M.D., Fenton Cawthorne House, Lancaster: the *Reserve Number* and *Highly Commended* for "Billy," red and white, 3 years, 10 months, 2 weeks-old; bred by Mr. J. De Geris, Vrais St. Peter's, Guernsey; sire, "Rover;" dam, "Blanche," by "Prince."

Guernsey Cows, in-milk or in-calf.

James James, of Les Vauxbelets: First Prize, 15*l.*, for "Lady Emily Foley 2nd," orange fawn and white, 4 years, 1 month-old; in-calf; bred by Mr. W. M. Jones, La Marcherie, Guernsey; dam, "Lady Emily Foley": Second Prize, 10*l.*, for "Valentine 3rd of Les Vauxbelets," cream and white, 6 years, 6 months, 4 weeks-old; in-milk; bred by himself; sire, "Lord of Vauxbelets;" dam, "Valentine 1st of Vauxbelets:" and the *Reserve Number* and *Highly Commended* for "Florence 2nd," fawn and white, 3 years, 11 months, 1 week, 2 days-old: in-milk; bred by Mr. W. M. Jones, La Marcherie, Guernsey; sire, "Billy;" dam, "Florence 1st."

Guernsey Heifers, not exceeding Three Years old.

James James, Les Vauxbelets: First Prize, 15*l.*, for "Wild Eyes 2nd," orange fawn, 1 year, 10 months, 2 weeks, 4 days-old; in-calf; bred by himself; sire, "Chieftain of Les Vauxbelets;" dam, "Wild Eyes 1st:" Second Prize, 10*l.*, for "Dairymaid 2nd of Les Vauxbelets," cream, 1 year, 10 months, 5 days-old; in-calf; bred by himself; sire, "Chieftain of Les Vauxbelets;" dam, "Dairymaid," by "Lord of the Isles;" g. d., "Dairymaid:" and the *Reserve Number* and *Highly Commended* for "Rosebud 4th of Les Vauxbelets," orange fawn, 1 year, 11 months, 3 weeks, 4 days-old; in-calf; bred by himself; sire, "Chieftain of Les Vauxbelets;" dam, "Rosebud of Les Vauxbelets," by "Lord of the Isles;" g. d., "Bo-Peep."

Norfolk and Suffolk Polled Bulls, above Two Years old.

William A. Tyssen-Amherst, M.P., Didlington Hall, Brandon, Norfolk: First Prize, 15*l.*, for "Davyson 3rd" (48), red, 7 years, 10 months-old; bred by Mr. J. Hammond, Bale, Norfolk; sire, "The Baron" (9); dam, "Davy 7th," by "Young Duke;" g. d., "Davy 2nd," by "Sir Nicholas" (202); gr. g. d., "Davy" (H 1).

Jeremiah J. Colman, M.P., Carrow House, Norwich: Second Prize, 10*l.*, for "Rufus," red, 7 years, 8 months, 2 weeks, 6 days-old; bred by the

late Lord Sondes, Elmham; sire, "The Palmer;" dam, "Thursford Rose," by "Norfolk Duke;" g. d., "Rose."

THE DUKE OF HAMILTON AND BRANDON, K.T., Easton Park, Wickham Market, Suffolk: the *Reserve Number* and *Highly Commended* for "The Monk," red, 2 years, 11 months-old; bred by himself; sire, "Marquis" (344); dam, "Kattie" (975), by "Benedict;" g. d., "Ringlet 2nd" (A 4), by "Tenant Farmer; gr. g. d., "Ringlet," by "Hero of Newcastle" (85).

Norfolk and Suffolk Polled Bulls, not exceeding Two Years old.

R. E. LOFFT, Troston Hall, Bury St. Edmund's, Suffolk: FIRST PRIZE, 15*l.*, for "Rinaldo," red, 1 year, 6 months, 2 weeks, 1 day-old; bred by himself; sire, "Stout;" dam, "Bridesmaid 6th," by "Donald" (291); g. d., "Bridesmaid 3rd," by "Cherry Duke" (32); gr. g. d., "Bridesmaid 1st," by "Rudham Bull."

ALFRED TAYLOR, Starston, Harleston, Norfolk: the *Reserve Number* and *Highly Commended* for "Starston Duke," red, 1 year, 7 months, 3 weeks, 2 days-old; bred by himself; sire, "King Charles" (329); dam, "Flirt" (894), by "Easton Duke" (61); g. d., "Sly" (1192), by "Sir Edward 1st" (197); gr. g. d., "Strawberry 2nd," by "Richard 2nd" (173).

Norfolk and Suffolk Polled Cows, in milk or in-calf, above Three Years old.

ALFRED TAYLOR, Starston: FIRST PRIZE, 15*l.*, for "Flirt," (894), red, 4 years, 11 months, 5 days-old; in-milk; bred by himself; sire, "Easton Duke" (61); dam, "Sly" (1192), by "Sir Edward 1st" (197); g. d., "Strawberry 2nd," by "Richard 2nd" (173); gr. g. d., "Tiny" (R 2), by "Laxfield Sire" (101).

JEREMIAH J. COLMAN, M.P., Carrow House, Norwich: SECOND PRIZE, 10*l.*, for "Silence," red, 3 years, 6 months, 3 days-old; in-milk; bred by himself; sire, "Disraeli;" dam, "Silent Lass," by "Powell;" g. d., "Silence," by "Rifleman;" gr. g. d., "Silence."

ROBERT EMLYN LOFFT, Troston Hall, Bury St. Edmunds: the *Reserve Number* and *Highly Commended* for "Minnie 3rd," red, 10 years, 5 months-old; in-milk and in-calf; bred by the late Lord Sondes, Elmham, Norfolk; sire, "Hammond" (81); dam, "Minnie 1st," by "Hector Page" (120).

Norfolk and Suffolk Polled Heifers, in-milk or in-calf, above Two and not exceeding Three Years old.

JEREMIAH J. COLMAN, M.P., Carrow House, Norwich: FIRST PRIZE, 15*l.*, for "Cherryleaf," red, 2 years, 8 months, 2 weeks, 1 day-old; in-calf; bred by himself; sire, "The Beau;" dam, "Cherry 5th," by "Norfolk Duke;" g. d., "Cherry 2nd."

ALFRED TAYLOR, Starston, Harleston, Norfolk: SECOND PRIZE, 10*l.*, for "Blossom," red, 2 years, 8 months, 3 weeks-old; in-calf; bred by Mr. J. F. Palmer, Wilby, Attleborough; sire, "Davyson 3rd" (40); dam, "Nancy 2nd," by "Young Major" (235) ;g. d., "Nancy," by Peck;" gr. g. d., "Spot 3rd" (K 19).

WILLIAM A. TYSSEN-AMHERST, M.P., Didlington Hall, Brandon: the *Reserve Number* and *Highly Commended* for "Countess" (1407), red, about 2 years, 2 months-old; in-calf; bred by Mr. T. Fulcher, Elmham,

Norfolk; sire, "Lord of the Manor" (338); dam, "Lass" (988), by "Elmham Bull;" g. d., "Letton" (L 11).

Norfolk and Suffolk Polled Heifers, not exceeding Two Years old.

JEREMIAH J. COLMAN, M.P., Carrow House: FIRST PRIZE, 10*l.*, for "Dolly," red, 1 year, 7 months, 4 weeks-old; bred by himself; sire, "Rufus" (188); dam, "Polly," by "Rufus" (189); g. d., "Lily 2nd," by "Hero 3rd;" gr. g. d., "Lily:" SECOND PRIZE, 5*l.*, for "Rosamond," red, 1 year, 8 months, 2 weeks, 1 day-old; bred by himself; sire, "Rufus;" dam, "Rosa," by "Norfolk Duke;" g. d., "Rose 3rd," by "Young Duke;" gr. g. d., "Rose 2nd."

R. E. LOFFT, Troston Hall, Bury St. Edmunds: the *Reserve Number* and *Highly Commended* for "Newbourne Pride 8th," red, 1 year, 11 months, 1 week, 6 days-old; in-calf: bred by himself; sire, "Stout;" dam, "Newbourne Pride 5th," by "Honest Tom;" g. d., "Newbourne Pride 2nd," by "Glatton" (79); gr. g. d., "Newbourne Pride 1st," by "Garibaldi" (73).

*Dairy Cows—Four of any breed.**

EDWARD VALE, Breadsall, Derby: FIRST PRIZE, 20*l.*, one 4 year-old, three 5 years-old, red; breeders unknown.

GEORGE FERME, Leigham Lodge Farm, Roupell Park, Streatham Hill, Surrey: SECOND PRIZE, 10*l.*, for "Lady Ann," "Lady Jane," "Lady Margaret," "Lady Mary," Ayrshires, about 4 years-old, brown and white; breeders unknown.

*Dairy Heifers—Pair of any breed, under Three Years old.**

GEORGE FERME, Leigham Lodge Farm: FIRST PRIZE, 10*l.*, for "Lady Bell" and "Lady Betty," Ayrshires, about 2 years, 10 months-old, brown and white; breeders unknown.

SHEEP.

Leicester Shearling Rams.

TEASDALE HILTON HUTCHINSON, Manor House, Catterick, Yorkshire: FIRST PRIZE, 15*l.*; SECOND PRIZE, 10*l.*; THIRD PRIZE, 5*l.*, for his 1 year, 3 months-old; all bred by himself.

ROBERT WARD CRESWELL, Ravenstone, Ashby-de-la-Zouch: the *Reserve Number* to his 1 year, 4 months-old; bred by himself.

Leicester Rams of any other age.

TEASDALE HILTON HUTCHINSON, Manor House: FIRST PRIZE, 15*l.*, for his "Royal Carlisle," 2 years, 3 months-old; bred by himself; sire, "Royal Liverpool:" and SECOND PRIZE, 10*l.*, for his 2 years, 3 months-old; bred by himself; sire, "Royal Liverpool."

ERNEST FRANCIS JORDAN, Eastburn, Driffield, Yorkshire: THIRD PRIZE, 5*l.*, for his 2 years, 3 months-old; bred by the executors of the late Francis Jordan.

GEORGE TURNER, jun., Thorplands, Northampton: the *Reserve Number* to his 3 years, 3 months, 2 weeks-old; bred by himself.

Leicester Shearling Ewes—Pens of Five.

MRS. PERRY HERRICK, Beau Manor Park, Loughborough, Leicestershire: FIRST PRIZE, 15*l.*; and SECOND PRIZE, 10*l.*, for her 1 year, 3 months, 2 weeks-old; both bred by herself.

ERNEST FRANCIS JORDAN, Eastburn, Driffield, the *Reserve Number* and *Highly Commended* for his 1 year, 3 months-old; bred by himself.

Cotswold Shearling Rams.

RUSSELL SWANWICK, the Royal Agricultural College Farm, Cirencester, Gloucestershire: FIRST PRIZE, 15*l.*, for his about 1 year, 5 months-old; bred by himself.

THOMAS BROWN, Marham Hall, Downham Market, Norfolk: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

RUSSELL SWANWICK, the Royal Agricultural College Farm: THIRD PRIZE, 5*l.*, for his about 1 year, 5 months-old; bred by himself.

ROBERT JACOBS, Signet Hill, Burford, Oxon: the *Reserve Number* and *Highly Commended* for his 1 year, 4 months-old; bred by himself.

Cotswold Rams of any other age.

RUSSELL SWANWICK, the Royal Agricultural College Farm: FIRST PRIZE, 15*l.*, for his 3 years, 5 months-old; bred by himself.

THOMAS and STEPHEN GEORGE GILLETT, Kilkenny Farm, Faringdon, Oxfordshire: SECOND PRIZE, 10*l.*, for their 4 years, 3 months, 2 weeks-old; bred by themselves.

RUSSELL SWANWICK, the Royal Agricultural College Farm: the *Reserve Number* and *Highly Commended* for his 3 years, 5 months-old; bred by himself.

Cotswold Shearling Ewes—Pens of Five.

THOMAS and STEPHEN GEORGE GILLETT, Kilkenny Farm, Faringdon, Oxfordshire: FIRST PRIZE, 15*l.*; and SECOND PRIZE, 10*l.*, for their 1 year, 4 months, 2 weeks-old; both bred by themselves.

EDWARD TOMBS, Shilton Bampton, Oxfordshire: the *Reserve Number* and *Highly Commended* for his 1 year, 5 months, 2 weeks-old; bred by himself.

Lincoln Shearling Rams.

ROBERT WRIGHT, Nocton Heath, Lincoln: FIRST PRIZE, 15*l.*, and SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; both bred by himself.

HENRY SMITH, The Grove, Cropwell Butler, Nottingham: THIRD PRIZE, 5*l.*, for his 1 year, 3 months-old; bred by himself.

JOHN PEARS, Mere, Lincoln: the *Reserve Number* and *Highly Commended* for his 1 year, 4 months-old; bred by himself.

Lincoln Rams of any other age.

HENRY SMITH, The Grove, Cropwell Butler, Nottingham: FIRST PRIZE, 15*l.*, for his "Manchester," 3 years, 4 months-old; bred by himself; sire,

"Ninety:" SECOND PRIZE, 10*l*., for his "Lord Lyons," 2 years, 3 months-old; bred by himself; sire, "Ninety:" and THIRD PRIZE, 5*l*., for his "Starnhill," 2 years, 3 months-old; bred by himself; sire, "Monster."

JOHN PEARS, Mere, Lincoln: the *Reserve Number* and *Highly Commended* for his 2 years, 4 months-old; bred by himself.

Lincoln Shearling Ewes—Pens of Five.

ROBERT WRIGHT, Nocton Heath, Lincoln: FIRST PRIZE, 15*l*., for his 1 year, 4 months-old; bred by himself.

JOHN BYRON, Kirkby Green, Sleaford, Lincolnshire: SECOND PRIZE, 10*l*., for his 1 year, 3 months, 2 weeks-old; bred by himself.

JOHN PEARS, Mere, Lincoln: the *Reserve Number* and *Highly Commended* for his 1 year, 4 months-old; bred by himself.

*Lincoln Breeding Ewes—Pens of Ten.**

WILLIAM ROE, North Scarle Field, Newark, Notts: FIRST PRIZE, 10*l*., ages various; bred by himself.

JOHN BYRON, Kirkby Green, Sleaford, Lincolnshire: SECOND PRIZE, 5*l*., ages various; bred by himself.

Other Long-wools—Shearling Rams.

SIR JOHN HEATHCOAT HEATHCOAT-AMORY, Bart., M.P., Knightshays Court: FIRST PRIZE, 10*l*., for his Devon Long-wool "Comet," 1 year, 4 months-old; bred by himself.

JAMES THOMPSON, Singleton Park, Kendal, Westmoreland: SECOND PRIZE, 5*l*., for his "Westmoreland," Long-wool, 1 year, 3 months, 3 weeks-old; bred by Mr. Sedgwick, Singleton Park, Kendal.

SIR JOHN HEATHCOAT HEATHCOAT-AMORY, Bart., M.P., Knightshays Court, Tiverton: the *Reserve Number* and *Highly Commended* for his Devon Long-wool, "Goliah," 1 year, 4 months-old; bred by himself.

Other Long-wools—Rams of any other age.

SIR JOHN HEATHCOAT HEATHCOAT-AMORY, Bart., M.P., Knightshays Court, Tiverton: FIRST PRIZE, 10*l*., for his Devon Long-wool, "Kilburn," 3 years, 4 months-old; bred by himself: SECOND PRIZE, 5*l*., for his Devon Long-Wool, 2 years, 4 months-old; bred by himself.

WILLIAM and GEORGE BIRD, Volis, Kingston, Taunton: the *Reserve Number* and *Highly Commended* for their Devon Long-wool, 2 years, 5 months-old; bred by themselves.

Other Long-wools—Shearling Ewes—Pens of Five.

SIR JOHN HEATHCOAT HEATHCOAT-AMORY, Bart., M.P., Knightshays Court, Tiverton, FIRST PRIZE, 10*l*., for his Devon Long-wool, 1 year, 4 months-old; bred by himself.

CHARLES NORRIS, Motion, Exeter: SECOND PRIZE, 5*l*., for his Devon Long-wool, 1 year, 5 months-old; bred by himself.

*Long-wools—Pens of Ten Breeding Ewes.**

CHARLES NORRIS, Motion, Exeter: FIRST PRIZE, 10*l*., for his Devon Long-wool, ages various; bred by himself.

Oxfordshire Down Shearling Rams.

ALBERT BRASSEY, Heythrop Park, Chipping Norton, Oxon.: FIRST PRIZE, 15*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

JOHN TREADWELL, Upper Winchendon, Aylesbury, Bucks: SECOND PRIZE, 10*l.*, for his "Baron Newton," about 1 year, 4 months, 2 weeks-old: bred by himself; THIRD PRIZE, 5*l.*, for his "Baron Derby," about 1 year, 4 months, 2 weeks-old; bred by himself: and the *Reserve Number* and *Highly Commended* for his "Baron Behmer," about 1 year, 4 months, 2 weeks-old; bred by himself; sire, "The Swell."

Oxfordshire Down Rams of any other age.

JOHN TREADWELL, Upper Winchendon, Aylesbury: FIRST PRIZE, 15*l.*, for "Prince of Wales," 3 years, 4 months, 2 weeks-old; bred by himself; sire, "The Swell"; dam by "Guildford."

GEORGE STREET, Maulden Ampthill, Bedforshire: SECOND PRIZE, 10*l.*, for "The Shah," 3 years, 4 months, 2 weeks-old: bred by himself; sire, "The Gentleman."

JAMES and FREDERICK HOWARD, Britannia Farms, Bedford: the *Reserve Number* and *Highly Commended* for their "Maiseyhampton," 3 years, 4 months-old; bred by Mr. Charles Hobbs, Maiseyhampton, Cirencester.

Oxfordshire Down Shearling Ewes—Pens of Five.

FREDERIC STREET, Somersham Park, St. Ives, Hunts: FIRST PRIZE, 15*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself; sire, "Aristocrat."

CHARLES HOWARD, Biddenham, Bedford: SECOND PRIZE, 10*l.*, for his 1 year, 4 months, 2 weeks-old; bred by himself.

JAMES and FREDERICK HOWARD, Britannia Farms, Bedford: the *Reserve Number* and *Highly Commended* for their 1 year, 4 months-old; bred by themselves.

Shropshire Shearling Rams.†

THOMAS S. MINTON, Montford, Montford Bridge, R.S.O. Salop: FIRST PRIZE, 20*l.*, for his 1 year, 3 months-old; bred by himself.

JAMES LENOX NAPER, Loughcrew, Oldcastle, Ireland: SECOND PRIZE, 15*l.* for his 1 year, 4 months-old; bred by himself.

GEORGE GRAHAM, The Oaklands, Birmingham: THIRD PRIZE, 10*l.*, for his 1 year, 3 months, 1 week-old; bred by himself.

THOMAS S. MINTON, Montford: FOURTH PRIZE, 5*l.*, for his 1 year, 3 months-old; bred by himself.

THOMAS JAMES MANSELL, Dudmaston Lodge, Bridgnorth, Salop: the *Reserve Number* and *Highly Commended* for his 1 year, 4 months, 3 weeks-old; bred by himself.

Shropshire Rams of any other age.

THOMAS JAMES MANSELL, Dudmaston Lodge, Bridgnorth: FIRST PRIZE, 20*l.*, for "Dudmaston Hero," 2 years, 4 months, 2 weeks-old; bred by himself; sire, "Pride of Montford;" dam by "Truestock."

THOMAS S. MINTON, Montford, Montford Bridge, R.S.O.: SECOND PRIZE, 15*l.*, for "Royal Reserve," 3 years, 3 months-old; bred by Mr. Bromley.

---

† Towards the Shropshire Prizes, 80*l.* was given by a Committee of Shropshire Breeders.

JOHN EDWARD FARMER, Felton, Ludlow, Salop: THIRD PRIZE, 10*l.*, for "Carlisle," 3 years-old; bred by Messrs. Crane and Tanner, Shrawardine, Shrewsbury; sire, "Dudmaston;" dam by "Caligula."

EDWARD CRANE and ALFRED TANNER, Shrawardine, Montford Bridge, R.S.O., Shropshire: FOURTH PRIZE, 5*l.*, for "Lord Oxford," 3 years, 3 months, 3 weeks-old; bred by themselves; sire, "Columbus;" dam by "Claudius."

THE DUKE OF PORTLAND, Clipstone Park Farm, Mansfield, Notts: the *Reserve Number* and *Highly Commended* for his 3 years, 3 months, 2 weeks-old; bred by himself.

Shropshire Shearling Ewes—Pens of Five.

JOSEPH BEACH, The Hattons, Brewood, Staffs.: FIRST PRIZE, 20*l.*, for his 1 year, 4 months-old; bred by himself.

GEORGE GRAHAM, The Oaklands, Birmingham: SECOND PRIZE, 15*l.*, for his 1 year, 3 months-old; bred by himself.

WILLIAM GERMAN, Measham, Lodge, Atherstone: THIRD PRIZE, 10*l.*, for 1 year, 4 months-old; bred by himself.

GEORGE GRAHAM, The Oaklands: FOURTH PRIZE, 5*l.*, for his 1 year, 3 months, 2 weeks old; bred by himself.

THOMAS S. MINTON, Montford: the *Reserve Number* and *Highly Commended* for his 1 year, 3 months old; bred by himself.

Shropshire Breeding Ewes—Pens of Ten.

ROBERT LODER, M.P., of Whittlebury, Towcester, Northamptonshire: FIRST PRIZE, 10*l.*; ages various.

RICHARD THOMAS, The Buildings, Baschurch, Salop: SECOND PRIZE, 10*l.*;* ages various; bred by himself.

GEORGE GERMAN, Snarestone Atherstone: THIRD PRIZE, 5*l.*;* ages various; bred by himself.

THOMAS MILLER, Singleton Park, Poulton-le-Fylde, Lancashire: the *Reserve Number* and *Highly Commended*; ages various.

Southdown Shearling Rams.

WILLIAM RIGDEN, Ashcroft, Kingston-by-Sea, Brighton, Sussex: FIRST PRIZE, 15*l.*, and SECOND PRIZE, 10*l.*, for his 1 year, 4 months-old; both bred by himself.

JEREMIAH J. COLMAN, M.P., Carrow House, Norwich: THIRD PRIZE, 5*l.*, and the *Reserve Number* and *Highly Commended* for his 1 year, 4 months-old; both bred by himself.

Southdown Rams of any other age.

THE DUKE OF RICHMOND AND GORDON, K.G., Goodwood, Chichester, Sussex: FIRST PRIZE, 15*l.*, for his 3 years, 4 months-old; bred by himself.

WILLIAM RIGDEN, Ashcroft, Kingston-by-Sea, Brighton: SECOND PRIZE, 10*l.*, for his 3 years, 4 months-old; bred by himself.

LORD WALSINGHAM, Merton Hall, Thetford, Norfolk: THIRD PRIZE, 5*l.*, for his 2 years, four months-old; bred by himself.

WILLIAM RIGDEN, Ashcroft: the *Reserve Number* and *Highly Commended* for his 2 years, 4 months-old; bred by himself.

Southdown Shearling Ewes—Pens of Five.

Jeremiah J. Colman, M.P., of Carrow House, Norwich: First Prize, 15*l.*, for his 1 year, 4 months-old; bred by himself.

Lord Walsingham, Merton Hall, Thetford, Norfolk: Second Prize, 10*l.*, for his 1 year, 4 months-old; bred by himself.

Sir William Throckmorton, Bart., Buckland, Faringdon, Berks: Third Prize, 5*l.*, for his 1 year, 4 months-old; bred by himself.

Charles Chapman, Frocester Court, Stonehouse, Gloucestershire: the *Reserve Number* and *Highly Commended* for his 1 year, 3 months, 2 weeks-old; bred by himself.

Hampshire and other Short-woolled Shearling Rams.

Alfred Morrison, Fonthill House, Tisbury, Wilts: First Prize, 15*l.*, Second Prize, 10*l.*, and Third Prize 5*l.*, for his 1 year, 5 months-old; all bred by himself.

Frank R. Moore, Littlecott, Pewsey, Wilts: the *Reserve Number* and *Highly Commended* for his 1 year, 5 months-old; bred by himself.

Hampshire and other Short-woolled Rams of any other age.

Alfred Morrison, Fonthill House, Tisbury, Wilts: First Prize, 15*l.*, for his 3 years, 4 months, 2 weeks-old; bred by himself.

Henry Lambert, Great Abington, Cambridge: Second Prize, 10*l.*, for his 2 years, 4 months, 2 weeks-old; bred by himself.

Alfred Morrison, Fonthill House: Third Prize, 10*l.*, and the *Reserve Number* and *Highly Commended* for his 2 years, 5 months-old; both bred by himself.

Hampshire and other Short-woolled Shearling Ewes—Pens of Five.

James Read, Homington, Salisbury, Wilts: First Prize, 15*l.*, for his 1 year, 5 months, 3 weeks-old; bred by himself.

William Parsons, West Stratton, Micheldever, Hants: Second Prize, 10*l.*, for his 1 year, 5 months, 1 week-old; bred by himself.

J. A. and T. Palmer, Nine Mile Water, Broughton, Stockbridge, Hants: Third Prize, 5*l.*, for their 1 year, 5 months, 2 weeks-old; bred by themselves.

Henry Lambert, Great Abington, Cambridge: the *Reserve Number* and *Highly Commended* for his 1 year, 5 months, 2 weeks-old; bred by himself.

PIGS.

Large White Breed—Boars, above Six Months and not exceeding Twelve Months old.

The Earl of Ellesmere, Worsley Hall, Lancashire: First Prize, 10*l.*, for his 11 months, 3 weeks-old; bred by himself; sire, "Joseph;" dam, "King Colley."

Tom Strickland, Thirsk Junction, Thirsk, Yorkshire: Second Prize, 5*l.*, for his 9 months, 3 weeks, 6 days-old; bred by himself.

JOHN and JOSEPH NUTTALL, 22, Longfield, Haywood, Lancashire; the *Reserve Number* to "Sampson," 9 months, 1 week, 6 days-old; bred by themselves; sire, "Bill;" dam, "Lancashire Sall," by "Jack it Bullock."

Large White Breed—Boars, above Twelve Months old.

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: FIRST PRIZE, 10*l.*, for "Samson 4th," 4 years, 6 months-old; bred by himself; sire, "Samson;" dam by "Yorkshire Lad."

SANDERS SPENCER, Holywell Manor, St. Ives, Hunts: SECOND PRIZE, 5*l.*, for "Sampson 6th," 2 years, 11 months, 3 weeks, 6 days-old; bred by himself; sire, "Sampson 2nd;" dam, "Giantess."

GEORGE HODGKINSON, Kirkby Mansfield, Kirkby: the *Reserve Number* and *Highly Commended* for "Chaddesden," 3 years, 10 months-old; bred by himself; sire, "Sampson 2nd."

Large White Breed—Breeding Sow Pigs, Pens of Three, above Three and not exceeding Six Months old.

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: FIRST PRIZE, 10*l.*, for his 5 months, 3 weeks, 3 days-old; bred by himself; sire, "Tiger 3rd;" dam by "Samson."

ROBERT TOMMAS, Winson Green, Birmingham: SECOND PRIZE, 5*l.*, for his 5 months, 3 weeks-old; bred by himself; sire, "Prince;" dam, "Tigress," by "Emperor."

JOHN and JOSEPH NUTTALL, 22, Longfield, Haywood, Lancashire: the *Reserve Number* and *Highly Commended* for their 5 months, 1 week, 6 days-old; bred by themselves; sire, "Bill;" dam, "Lancashire Sall," by "Jack it Bullock."

Large White Breed—Breeding Sows.

WILLIAM HALL, Manor Farm, Belper, Derbyshire: FIRST PRIZE, 10*l.*, for his 2 years, 5 months, 1 week, 1 day-old; bred by himself.

THE EARL OF ELLESMERE, Worsley Hall, Lancashire: SECOND PRIZE, 5*l.*, for his 6 years, 6 months-old; bred by Mr. M. Walker, Derby; sire, "Samson;" dam by "Victor 2nd."

F. A. WALKER-JONES, Mollington, Chester; the *Reserve Number* and *Highly Commended* for his "Great Eastern," about 3 years, 4 months-old; breeder unknown.

Small White Breed—Boars, above Six Months and not exceeding Twelve Months old.

LORD MORETON, M.P., Tortworth Court, Falfield, Gloucerstershire: FIRST PRIZE, 10*l.*, for his 11 months, 2 weeks, 5 days-old; bred by himself; sire, "Purity;" dam, "Spot 2nd," by "Barrister."

SANDERS SPENCER, Holywell Manor, St. Ives, Hunts: SECOND PRIZE, 5*l.*, for "Esau 3rd," 9 months, 2 weeks-old; bred by himself; sire, "Omega;" dam, "Sister to Sylph," by "Pat."

THE EARL OF ELLESMERE, Worsley Hall: the *Reserve Number* and *Highly Commended* for his 8 months, 2 weeks-old; bred by himself; sire, "King Koffee;" dam, "Miss Morris."

Small White Breed—Boars, above Twelve Months old.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*, for "Robin Hood," 2 years, 9 months, 3 weeks-old; bred by himself; sire, "King of the Peacocks;" sire of dam, "Toxophilite."

PHILIP ASHCROFT, Rufford, Ormskirk, Lancashire: SECOND PRIZE, 5*l.*; for his 1 year, 1 month, 4 days-old; bred by Mr. Samuel Wilson, Tanner's Farm, Ramsbottom, Lancashire.

SANDERS SPENCER, Holywell Manor: the *Reserve Number* and *Highly Commended* for "Sugar," 1 year, 10 months, 3 weeks, 1 day-old; bred by himself; sire, "Pat;" dam, "Sister to Esau," by "Puritan."

Small White Breed Breeding Sow Pigs—Pens of Three, above Three and not exceeding Six Months old.

THE EARL OF ELLESMERE, Worsley Hall: FIRST PRIZE, 10*l.*, for his 3 months, 3 weeks-old; bred by himself; sire, "King Koffee;" dam, "Yorkshire Duchess."

LORD MORETON, M.P., Tortworth Court, Falfield: SECOND PRIZE, 5*l.*, for his 3 months, 3 weeks, 1 day-old; bred by himself; sire, "Convict;" dam, "Worcester 3rd," by "Barrister."

JOHN ATKINSON WALTON, Lockington, Derby: the *Reserve Number* to his 3 months, 1 week-old; bred by himself.

Small White Breed—Breeding Sows.

CHARLES ELMHIRST DUCKERING, Northorpe, Kirton-Lindsey, Lincolnshire: FIRST PRIZE, 10*l.*, for his 1 year, 5 months, 4 days-old; bred by himself.

SANDERS SPENCER, Holywell Manor, St. Ives, Hunts: SECOND PRIZE, 5*l.*, for his 1 year, 11 months, 3 weeks, 6 days-old; bred by himself; sire, "Pat;" dam, "Oh Yes," by "The Czar."

F. A. WALKER-JONES, Mollington, Chester: the *Reserve Number* and *Highly Commended* for his 1 year, 9 months, 2 weeks, 4 days-old; bred by himself; sire, "Roger;" dam, "Loo."

Small Black Breed—Boars, above Six and not exceeding Twelve Months old.

HENRY CHARLES BLISS GILBERT, Braydestone Hall, Blofield, Norfolk: FIRST PRIZE, 10*l.*, for "Sir Charles," 11 months, 4 weeks, 1 day-old; bred by Major William Dods, Gorlestone, Great Yarmouth, Norfolk; sire, "Camballo;" dam, "May," by "Top Sawyer."

CHARLES ELMHIRST DUCKERING, Northorpe, Kirton-Lindsey: SECOND PRIZE, 5*l.*, for his 10 months-old; bred by himself.

REV. WILLIAM HOOPER, Chilfrome Rectory, Dorchester: the *Reserve Number* and *Highly Commended* for "Joubert," 9 months, 4 weeks-old; bred by himself.

Small Black Breed Boars, above Twelve Months old.

WILLIAM WHEELER, Long Compton, Shipston-on-Stour: FIRST PRIZE, 10*l.*, for his 1 year, 10 months, 2 days-old; bred by Mr. Charles Wheeler, Long Compton.

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey, Lincolnshire: Second Prize, 5*l.*, for his 1 year, 10 months, 3 weeks, 2 days-old; bred by himself.

Rev. William Hooper, Chilfrome Rectory, Dorchester: the *Reserve Number* and *Highly Commended* for "Gipsy King," 2 years, 1 month, 1 week-old; bred by himself; sire, "Sultan."

Small Black Breeding Sow Pigs—Pens of Five, above Three and not exceeding Six Months old.

The Duke of Hamilton and Brandon, K.T., Easton Park, Wickham Market, Suffolk: First Prize, 10*l.*, for his 5 months-old; bred by himself; sire, "Sam;" dam, "Jet 3rd," by "Rattling Jack."

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey: Second Prize, 5*l.*, for his 5 months, 3 weeks-old; bred by himself.

Small Black Breeding Sows.

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey: First Prize, 10*l.*, for his 1 year, 8 months, 2 weeks, 2 days-old; bred by himself.

William Wheeler, Long Compton, Shipston-on-Stour: Second Prize, 5*l.*, for his 1 year, 10 months, 2 days-old; bred by Mr. Charles Wheeler, Long Compton.

The Duke of Hamilton and Brandon, K.T., Easton Park, Wickham Market: the *Reserve Number* and *Highly Commended* for "Jet 3rd," 2 years, 5 months, 3 weeks, 5 days-old, in-pig; bred by himself; sire, "Rattling Jack;" dam, "Old Jet," by "Doncaster."

Berkshires—Boars, above Six and not exceeding Twelve Months old.

Russell Swanwick, Royal Agricultural College Farm, Cirencester: First Prize, 10*l.*, for his 9 months, 2 weeks, 6 days-old; bred by himself; sire, "Wizard 3rd;" dam, "Sister of Lady Bath," by "Spiteful 1st."

The Executors of the late Arthur Stewart, Saint Bridge Farm, Gloucester: Second Prize, 5*l.*, for their 11 months, 4 weeks-old; bred by themselves; sire, "Prodigal;" dam, "Lady Kingscote."

Major Peploe, Garnstone Castle, Weobley, Herefordshire: the *Reserve Number* and *Highly Commended* for "Prince," 11 months, 2 weeks, 5 days-old; bred by himself; sire, "Soporific;" dam, "Spot," by "Scothern."

Berkshire—Boars, above Twelve Months old.

Russell Swanwick, Royal Agricultural College Farm, Cirencester: First Prize, 10*l.*, for "Prosperity," 1 year, 8 months, 4 weeks, 1 day-old; bred by himself; sire, "Gloucester;" dam, "Sister of Lady Bath," by "Spiteful 1st."

Charles Elmhirst Duckering, Northorpe, Kirton-Lindsey: Second Prize, 5*l.*, for his 2 years, 9 months, 1 week, 1 day-old; bred by himself.

Heber Humfrey, Kingstone Farm, Shrivenham: the *Reserve Number* and *Highly Commended* for "Sterling Value," 2 years, 2 weeks, 5 days-old; bred by himself; sire, "Happy Medium;" dam, "Ulster Lassie," by "Sir D. Cardiff."

Berkshires—Breeding Sow Pigs, Pens of Three, above Three and not exceeding Six Months old.

WILLIAM HEWER, Sevenhampton, Highworth, Wilts: FIRST PRIZE, 10*l.*, for his 5 months, 4 weeks, 1 day-old; bred by Mr. T. S. Hewer, Knighton Farm, Ramsbury, Wilts: sire, "Hopewell 2nd;" dam, "Knighton Lass," by "Wrangler."

THE EXECUTORS OF THE LATE ARTHUR STEWART, Saint Bridge Farm, Gloucester: SECOND PRIZE, 5*l.*, for their 4 months, 4 weeks, 1 day-old; bred by themselves; sire, "Exor;" dam, "Lady Kingscote 2nd," by "Prodigal."

CHARLES ELMHIRST DUCKERING, Northorpe, Kirton-Lindsey: the *Reserve Number* and *Highly Commended* for his 5 months, 3 weeks, 3 days-old; bred by himself.

Berkshire Breeding Sows.

THE EXECUTORS OF THE LATE ARTHUR STEWART, Saint Bridge Farm: FIRST PRIZE, 10*l.*, for their 11 months, 4 weeks-old; in-pig; bred by themselves; sire, "Prodigal;" dam, "Lady Kingscote."

RUSSELL SWANWICK, Royal Agricultural College Farm: SECOND PRIZE, 5*l.*, for his 9 months, 3 weeks, 6 days-old; in-pig; bred by himself; sire, "Wizard 3rd;" dam, "Sally 9th," by "Hopeful 1st."

CHARLES ELMHIRST DUCKERING, Northorpe, Kirton-Lindsey: the *Reserve Number* and *Highly Commended* for his 1 year, 11 months, 2 weeks-old; bred by himself.

CHEESE.*

Four Derbyshire or Leicestershire Cheeses, not less than 30 lbs. each, made in 1881.

RICHARD HARDY, Marchington, Uttoxeter, Staffs.: FIRST PRIZE, 10*l.*

HENRY GEORGE S. BROUGH, Brailsford, Derby: SECOND PRIZE, 5*l.*

Four Derbyshire Cheeses, above 20 lbs. and 30 lbs., made in 1881.

HENRY GEORGE S. BROUGH, FIRST PRIZE, 10*l.*

WILLIAM SAINT, Barton Park, Church Broughton, Derbyshire: SECOND PRIZE, 5*l.*

Half-Ton of British Cheese of any kind made in 1881.

JOHN GOULD, Aldford Cheese Factory, Saighton, Chester: FIRST PRIZE, 20*l.*

FREDERICK WILLIAM DAINTON, Aston-by-Budworth, Northwich, Cheshire: SECOND PRIZE, 10*l.*

BUTTER.*

Six lbs. of Fresh; the Produce of Channel Islands Cattle excluded.

Arthur Milner, Stretton, Alfreton, Derbyshire: First Prize, 5*l.*

George Sampson, jun., Bauchief Abbey, Sheffield: Second Prize, 4*l.*

Matthew Pickwell, Thorpe-on-the-Hill, Lincolnshire: Third Prize, 3*l.*

Uriah Slack, Leigh, Stoke-on-Trent, Staffs.: Fourth Prize, 2*l.*

Thomas S. T. Carrington, Eaton, Doveridge, Derby: Fifth Prize, 1*l.*

Six lbs. of Fresh, from Cows of any Breed.

Elias Flanders, 65, Wellington Street, Derby: First Prize, 5*l.*

Arthur Milner, Stretton, Alfreton: Second Prize, 4*l.*

Gerald Peel, Collar House, Presbury, Macclesfield: Third Prize, 3*l.*

Mrs. Terrot, Wispington Vicarage, Horncastle, Lincolnshire: Fourth Prize, 2*l.*

Thomas S. T. Carrington, Eaton, Doveridge, Derby: Fifth Prize, 1*l.*

BEE-KEEPING APPLIANCES.

For the best Exhibition of Hives and Bee Appliances.

G. Neighbour and Sons, 149, Regent Street, London; First Prize, 5*l.*; Second Prize, 3*l.*; Third Prize, 2*l.*

IMPLEMENTS.

Sheaf-Binders.

The M'Cormick Harvesting Machine Company, Chicago, Illinois, U.S.A., the Gold Medal for their String Sheaf-Binder.

Samuelson and Co., Banbury, Silver Medal for their String Sheaf-Binder.

The Johnston Harvester Co., 1 and 2, Chiswell Street, London, E.C., Silver Medal for their String Sheaf-Binder.

H. J. H. King, Newmarket, Stroud, Gloucestershire, *Highly Commended* for his principle of separating and tying sheaves.

Miscellaneous.

R. W. Tayler, Bury St. Edmund's, Suffolk, Silver Medal for his Guard for Circular Saw.

John H. Ladd & Co., 116, Queen Victoria Street, London, Silver Medal, for their Perpetual Baling Press.

FARM PRIZES.*

The best-managed Dairy Farm, above 150 *acres in extent.*

George Bryer, Markeaton Park, Derby: First Prize, 105*l.*

John Hellaby, Twyford, Derby: Second Prize, 52*l.* 10*s.*

Arthur Stretton, Wichnor Bridges, Lichfield, Special Prize, 25*l.*

The best-managed Dairy Farm, not exceeding 150 *acres.*

Arthur Milner, Stretton, Alfreton, Derbyshire: First Prize, 52*l.* 10*s.*

Second Prize withheld.

Arable or Mixed Farms, above 150 *acres in extent.*

Francis allen Price, Bainsheath, Appleby, Atherstone: First Prize, 52*l.* 10*s.*

Edward George Rossell, Stapleford, Nottingham: Second Prize, 26*l.* 5*s.*

AGRICULTURAL EDUCATION.

Examination Papers, 1881.

EXAMINATION IN AGRICULTURE.

Maximum Number of Marks, 200. Pass Number, 100.

Tuesday, May 10th, from 10 a.m. till 1 p.m.

1. On a farm consisting of 350 acres—of which 270 acres is arable and of medium quality fit to carry sheep, and 80 acres average pasture—bearing a rent and tithe rent charge of 500*l*. per annum, and subject to rates amounting to 4*s*. per acre, in a district the locality of which you may select.

The entry being at Michaelmas.

Give the approximate totals:—

(1.) Of the valuation on entry, stating whether the valuation on hay and straw of the last year's growth is at sale or feed value, whether the value or labour only is charged on farm-yard manure, in what way the valuation on fallows and roots is charged, and the nature of any other charges included.

(2.) Of the number of horses required and estimated cost.

(3.) Of the number of bullocks, description thereof, and estimated cost.

(4.) Of the number of breeding ewes, description thereof, and estimated cost.

(5.) Of the number of other sheep, description thereof, and estimated cost.

(6.) Of the number of pigs, description thereof, and estimated cost.

(7.) A list of waggons, carts, and principal implements required, and the aggregate cost thereof, including the cost of tools and sundries.

2. Give the heads of other necessary expenditure to carry on the farm for one year.

3. Give the probable receipts during the same period.

4. Show now the capital required to take and carry on the business, irrespective of necessary reserve to meet contingencies.

5. State the course of cropping you would pursue for the farm under consideration, tabulating the *shit*times for sowing each crop. A suitable system of manuring the same, and the quantity and cost of each manure per acre.

6. Should you propose to plough or cultivate any of the land by steam, if so, for what crops?

7. What means should you propose to adopt for cutting the hay and corn? Give your reason.

8. The ground having been brought into proper condition before sowing, what quantity of each crop per acre might be expected in an average season on the above farm—(corn to be stated in quarters and bushels; hay, straw, and roots in tons)?

9. How many sheep would be required to feed off 10 acres of average turnips from 1st November to the 1st April, and with what additional food, if any?

10. Describe a good succession of crops for keeping a breeding flock of sheep on a purely arable farm from Michaelmas to Michaelmas, naming the month in which each crop should be fit.

11. In rearing sheep, which do you consider the most critical period or periods in the first eighteen months of the animals' life? State the causes, and the best means of meeting or avoiding the danger.

12 Describe a good system of feeding—

(1.) Fatting bullocks in yards.
(2.) Store bullocks in yards.

13. What is a proper allowance of food and of what kinds for a working farm horse, in winter; and in summer?

14. Give a suitable course of cropping—

(1.) On a heavy land farm.
(2.) On a light land farm.

15. State the advantages and disadvantages of hiring a farm subject to valuation of hay and straw at *feed value* as against *sale value.*

16. What is a fair average quantity of milk in imperial gallons, and of butter in pounds, for a Shorthorn cow of mature age to yield per week when in full milk?

EXAMINATION IN CHEMISTRY.

Maximum Number of Marks, 200. Pass Number, 100.

Wednesday, May 11th, from 10 a.m. till 1 p.m.

I. General Chemistry.

1. Give an account of the chief characters, chemical and physical, of oxygen and sulphur. Give examples of compounds of the one which resemble in constitution and general characters those of the other.

2. Describe, and explain, some method of determining the percentage of carbonic acid gas in the air at any time and place.

3. Give examples of slow and of rapid oxidation. On what circumstance does the rusting of iron depend? Why is iron which has been washed in hydrochloric acid more quickly rusted than iron not so treated? Explain the production of sparks when iron is struck against stones.

4. Illustrate by some examples the law of multiple proportions in chemical combination.

5. Give an outline of the process of making sulphuric acid. What weight of sulphuric acid can be made from 1 cwt. of sulphur?

6. Give some explanation of the antiseptic action of the following several substances: sulphuric acid, lime, common salt; and of the deodorising action of chlorine and ozone.

7. By what means can nitrogen be made to unite chemically with oxygen? In what respects does atmospheric air differ from a chemical compound?

8. Calculate how much lime is required to liberate all the ammonia from 1 cwt. of sal-ammoniac. If the sal-ammoniac contain 10 per cent. of sulphate of ammonia, what difference will that make in the quantity of lime required?

9. Explain how sugar, starch, and cellulose are related to one another in chemical composition, and in properties.

10. By what tests can you detect (1) alumina, (2) silica, (3) a nitrate, (4) a mixture of salts of lime and magnesia?

N.B.—O : S : N : Cl : Ca = 16 : 32 : 14 : 35·5 : 40.

II. Agricultural Chemistry.

Wednesday, May 11th, from 2 p.m. till 5 p.m.

1. Point out the differences in the composition of sterile and fertile clay soils.

2. In what states of combination does potash occur in soils? On what soils are potash-manures likely to benefit the crops, and on what soils is the application of potash-salts inefficient?

3. What is the composition of Kainite? How much potash is there in a good sample of Kainite, and how do you determine the percentage of potash in it?

4. How do you ascertain whether a soil is likely to be benefited by lime? Under what circumstances is it more profitable to apply chalk to the land, and under what circumstances quick-lime?

5. Explain the fallacies involved in the so-called Humus theory, and at the same time point out in what way vegetable mould may contribute to the fertility of the soil.

6. Describe the changes which take place in the germination of barley. Point out the differences in the composition of malt and barley-meal.

7. What is the composition of raw and steamed bones? How do you detect the adulteration of gypsum, chalk, vegetable ivory, and of sand in bone-dust?

8. Write a short paper on the manufacture of Cheddar cheese.

9. A farmer has been in the habit of applying 3 cwts. of Peruvian guano to his wheat; the guano contained 10 per cent. of ammonia and 30 per cent. of phosphate of lime; he wants to apply to the wheat the same amounts of phosphate of lime and ammonia, which are contained in 3 cwts. of guano in the shape of some other artificial manure. What fertilising matters or mixed artificial manures might he use for that purpose, and in what proportion should they be used?

EXAMINATION IN MECHANICS AND NATURAL PHILOSOPHY.

Maximum Number of Marks, 200. Pass Number, 100.

Thursday, May 12th, from 10 a.m. till 1 p.m.

1. Three forces act in the plane of a rigid triangle at right angles to and through the middle points of its sides respectively; why will they balance each other if they all act inwards or all outwards and are proportional in magnitude to the sides on which they act?

If two of the above forces act inwards and the third outwards, find their resultant.

2. If one end of a rod rests against a smooth plane, in what direction does the mutual action between the rod and the plane take place?

A rod is placed with one end on the ground and the other against a wall; show that it would be impossible for it to stand if the ground were not rough?

3. A yard measure is of the same thickness throughout; it consists of three equal pieces jointed together; if one of the pieces is folded back upon the other, so that the whole is now 2 ft. long, where is the centre of gravity of the whole?

4. The centre of gravity of a wheelbarrow and its load is twice as far from the hands of the man who wheels it as from the axle of the wheel; if the weight of the whole is 180 lbs., what weight does the man support? If the wheel is 17 in. in diameter, what horizontal force must the man exert to get it over an obstacle an inch high—putting friction out of the question?

5. A particle moving from rest has its velocity uniformly accelerated; in half-a-minute from the beginning of the motion it describes a distance of 1500 yards; what is the numerical value of the acceleration? If the mass of the particle is 10 lbs., what is the numerical value of the force producing the acceleration, and what ratio does that force bear to the force of gravity in London ($g = 32{\cdot}2$) on 3 lb. of matter?

6. Define specific gravity, and describe any one method of finding the specific gravity of a liquid.

A glass ball weighs 7050 grains; it weights 4500 grains in water; and it weighs 4704 grains in a certain liquid: what is the specific gravity of the liquid?

7. Explain the action of the common syphon.

Everything else being the same, why should the velocity of the out-flow be greater, the greater the length of the longer leg?

8. Explain briefly the formation of hoar-frost, and particularly why it should often happen that it is formed on a grass-plot and not on a neighbouring gravel walk.

9. Explain the use of the fly-wheel of a steam-engine.

If the mass of a fly-wheel is 12 tons and is supposed to be uniformly distributed along the circumference of a circle 10 ft. in radius, and if the wheel makes 20 revolutions a minute, what is the numerical value of its kinetic energy, and how many foot-pounds of work would it do against a resistance before it was brought to rest?

EXAMINATION IN MENSURATION AND SURVEYING.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Thursday, May 12th, from 2 p.m. till 5 p.m.

1. What is a rod of brickwork? A wall a brick thick stands on footings four bricks deep, the first two courses being 2 bricks thick, the next two $1\frac{1}{2}$ brick thick: the height of the wall above the footings is 10 feet; assuming that a brick laid in mortar is 3 inches deep, how many rods of brickwork are there in 100 feet of the length of the wall?

2. How many tons of clay (sp. gr. 2) are required to cover an acre on an average depth of a quarter of an inch?

3. The pitch of a hipped roof is 2 vertical to 3 horizontal; it measures at the eaves 50 ft. by 30 ft.; how many ridge tiles 18 in. long are required to cover the hips and ridge?

4. A cylindrical bushel measure is 9 in. high, what is the area—measured internally—of the sides and of the base? (A gallon may be taken as $277\frac{1}{4}$ cub. in.)

5. The slope of a piece of road is 2 vertical to 21 horizontal; what is the inclination of the road to the horizon in degrees, minutes, and seconds?

6. A line A B is marked on the ground by pickets; there is a point P on the ground, but inaccessible; explain how to find the point in which a perpendicular drawn from P to A B meets A B.

7. The distance from A to B is 770 ft.; that from A to Q is 1620 ft.; the angle P A Q is $42° 20'$; determine (*a*) by construction, (*b*) by calculation; the length of P Q, and the length of the perpendicular let fall from A on P Q.

8. The distance between two points on the ground is known to be $1\frac{1}{4}$ miles; on a map they are found to be $13\frac{1}{2}$ in. apart; construct, to suit the map, a scale by which all distances from 10 yds. to 1000 yds. can be read. Draw by means of the scale a line to represent a quarter of a mile.

9. Draw a straight line to represent the plan of a road that has to be made, and mark on it in order A, B, C, D such that A B, B C, C D are 237·5 ft., 50 ft., 350 ft. respectively. The section of the ground made by a vertical plane through A D, is A P Q R, such that P is 50 ft. above B, Q is 20 ft. below C, and R is 30 ft. above D; the earth has to be moved in such a manner that the road may run at a uniform slope from A up to X a point vertically over C, and then at another uniform slope from X up to R; find the height of X above C, and the slopes of the road from A to X and from X to R.

EXAMINATION IN BOOK-KEEPING.

MAXIMUM NUMBER OF MARKS, 200. PASS NUMBER, 100.

Friday, May 13th, from 10 a.m. till 1 p.m.

Journalise and post in proper technical language and form the following imaginary transactions, and draw out therefrom a "Trial Balance," a "Profit and Loss Account," and a "Balance-sheet."

On 1st January, 1880, the affairs of Jas. Bush stood thus:—

Assets.

				£	*s.*	*d.*
Cash in hand	150	0	0			
Horse and Cart	45	0	0			
Farm Covenants	180	0	0			
Wheat and Barley in stacks, valued at	220	0	0			
Hay and Straw, valued at	130	0	0			
Oats, valued at	50	0	0			
11 bullocks, valued at	200	0	0			
				975	0	0

Liabilities.

				£	s.	d.
Due to J. Thorley for rent	60	0	0			
Promissory Note of Jas. Bush, due 10th inst., held by T. Brown	£140	0	0			
Overdrawn Account at London & County Bank and interest due thereon to date	410	0	0			
				610	0	0
Surplus of Assets over Liabilities				£365	0	0
1880.						
Jan. 3.—Bought from Fry and Co. linseed-cake, and paid cash for the same				22	15	0
,, 10.—Sold to Robert Chase 5 bullocks				125	0	0
,, 12.—Sold to J. Thorley as under :—						
Oats	10	0	0			
Barley	15	0	0			
and forwarded to him cash for balance of amount due to him for rent	35	0	0			
				60	0	0
,, 14.—Received of Robert Chase cash				125	0	0
,, 16.—Sold to Fry & Co. wheat				135	0	0
,, 17.—Paid to London and County	35	0	0			
Bank for reduction of overdraft	75	0	0			
For interest to 31st Dec., 1879	10	0	0			
				85	0	0
,, 18.—Paid for repairs to cart				7	6	0
,, 19.—Sold to Robert Chase 6 bullocks				156	0	0
,, 20.—Paid cash to T. Brown as holder of J. Bush's promissory note, due 10th inst.	140	0	0			
and interest thereon at 10 per cent. from due date ..	0	16	8			
				140	16	8
,, 26.—Received cash of Robert Chase				156	8	4
,, 27.—Purchased of Fry & Co. 5 qrs. maize at 28*s.*				7	0	0
,, 28.—Paid for Rates and Taxes				15	0	0
,, 31.—Amount owing to J. Thorley at this date for rent				20	0	0
,, 31.—Amount owing to London and County Bank for interest				1	10	3
,, 31.—At this date Jas. Bush had as under :—						
Hay and Straw, valued at	70	0	0			
Wheat and Barley in stacks, valued at	115	0	0			
Oats, valued at	16	0	0			
Horse and Cart, valued at	50	0	0			

EXAMINATION IN GEOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Friday, May 13th, from 2 p.m. till 5 p.m.

1. Define the nature and objects of geological science.

2. Give a classification of rocks (with examples) according to their different *modes of origin*.

3. Tabulate in descending order the subdivisions of the oolite series of rocks. Give their lithological characters, and mention some of their most characteristic fossils.

4. Describe the geological conditions which regulate the natural or artificial supply of water.

5. From what strata are the best rooting slates and flagstones obtained? How has their formation been explained?

6. Explain generally the reasons why rocks and soils are more or less fertile. Give some examples.

7. Name the kind of deposits which have been referred to a glacial period. How have they modified the physical and agricultural characters of the districts where they occur?

8. What is clay? How has it been formed? Name some of the chief clayey or argillaceous rocks.

9. Mention the chief building-stones and other economical substances obtained from the oolitic strata in England.

10. How would you distinguish calcareous from other rocks? Mention some rocks in the geological series which are almost entirely composed of calcareous matter, and others that are only partly formed of it.

11. Give a general view of the triassic strata as to their geological position, distribution, mineral character, and economical products.

12. Name the rocks and fossils on the table.

EXAMINATION IN BOTANY.

[It is expected that Eight Questions at least will be answered.]

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, May 14th, from 10 a.m. till 1 p.m.

1. What is the function of the leaf? Describe the structure of the stomata and their relation to the internal structure of the leaf?

2. Describe the difference in the growth of the stem and of the roots, and state the reasons that suggest themselves to you for this difference.

3. What organs in a plant are used to store up food? Give examples.

4. Explain the difference between the ovule and the seed, and state what produces the difference.

5. Describe the circulation of the sap in plants, and specify the structures through which the circulation takes place.

6. What is phyllotaxy?

7. Give the principal groups into which Cryptogamous plants are arranged, state the principal characters of the groups, and give an example of each.

8. Give an account of the potato disease; and state how you would treat a crop attacked by it.

9. What are the principal sources of the food of a plant, and how does it benefit from artificial manures?

10. What are the fundamental differences between the artificial system of the classification of Linnæus, and the natural system of Jussieu?

11. Give the technical names and Natural Orders of the carrot, beet, oats, cow-grass, rib-grass, and Timothy grass.

12. Describe in a systematic method the plants marked A. B, and C.

EXAMINATION IN ANATOMY AND ANIMAL PHYSIOLOGY.

MAXIMUM NUMBER OF MARKS, 100. PASS NUMBER, 50.

Saturday, May 14th, from 2 p.m. till 5 p.m.

1. Describe the general structure, position, and size of the heart in the Horse or Ox. Name its different cavities and the vessels connected therewith. State fully its action in carrying on the circulation of the blood, and the average number of its contractions in health.

2. Supposing the blood to vary in colour in the cavities of the heart, explain the chief causes of its varying hue, and the advantages and disadvantages connected therewith.

3. State how the normal temperature of the body is maintained, the means which are employed to ascertain its variations, and under what circumstances it is increased or diminished.

4. Describe briefly the processes of digestion and assimilation of the food, and say in what form its nutritive portions enter the system. State also the course which is taken by the vessels which convey the nutritive materials.

5. Name the position which is occupied by the liver. Describe its use, and say in what essential particular it differs from other glands of the body in effecting its secretion.

MEMORANDA.

Address of Letters.—The Society's office being situated in the postal district designated by the letter W, Members, in their correspondence with the Secretary, are requested to subjoin that letter to the usual address.

General Meeting in London, December 8th, 1881, at 12 o'clock.

General Meeting in London, May 22nd, 1882, at 12 o'clock.

Meeting at Reading, July, 1882.

Monthly Council (for transaction of business), at 12 o'clock on the first Wednesday in every month, excepting January, September, and October: open only to Members of Council and Governors of the Society.

Adjournments.—The Council adjourn over Passion and Easter weeks, when those weeks do not include the first Wednesday of the month; from the first Wednesday in August to the first Wednesday in November; and from the first Wednesday in December to the first Wednesday in February.

Office Hours.—10 to 4. On Saturdays, 10 to 2.

Diseases of Cattle, Sheep, and Pigs.—Members have the privilege of applying to the Veterinary Committee of the Society, and of sending animals to the Royal Veterinary College, Camden Town, N.W.—(A statement of these privileges will be found on page lxxxv. in this Appendix.)

Chemical Analysis.—The privileges of Chemical Analysis enjoyed by Members of the Society will be found stated in this Appendix (page lxxxvi.).

Botanical Privileges.—The Botanical and Entomological Privileges enjoyed by Members of the Society will be found stated in this Appendix (page lxxxix.).

Subscriptions.—1. Annual.—The subscription of a Governor is £5, and that of a Member £1, due in advance on the 1st of January of each year, and becoming in arrear if unpaid by the 1st of June. 2. For Life.—Governors may compound for their subscription for future years by paying at once the sum of £50, and Members by paying £10. Governors and Members who have paid their annual subscription for 20 years or upwards, and whose subscriptions are not in arrear, may compound for future annual subscriptions, that of the current year inclusive, by a single payment of £25 for a Governor, and £5 for a Member.

Payments.—Subscriptions may be paid to the Secretary, in the most direct and satisfactory manner, either at the Office of the Society, No. 12, Hanover Square, London, W., or by means of post-office orders, to be obtained at any of the principal post-offices throughout the kingdom, and made payable to him at the Vere Street Office, London, W.; but any cheque on a banker's or any other house of business in London will be equally available, if made payable on demand. In obtaining post-office orders care should be taken to give the postmaster the correct initials and surname of the Secretary of the Society (H. M. Jenkins), otherwise the payment will be refused to him at the post-office on which such order has been obtained; and when remitting the money-orders it should be stated by whom, and on whose account, they are sent. Cheques should be made payable as drafts on demand (not as bills only payable after sight or a certain number of days after date), and should be drawn on a London (not on a local country) banker. When payment is made to the London and Westminster Bank, St. James's Square Branch, as the bankers of the Society, it will be desirable that the Secretary should be advised by letter of such payment, in order that the entry in the banker's book may be at once identified, and the amount posted to the credit of the proper party. No coin can be remitted by post, unless the letter be registered.

New Members.—Every candidate for admission into the Society must be proposed by a Member; the proposer to specify in writing the full name, usual place of residence, and post-town, of the candidate, either at a Council meeting, or by letter addressed to the Secretary. Forms of Proposal may be obtained on application to the Secretary.

*** Members may obtain on application to the Secretary copies of an Abstract of the Charter and Bye-laws, of a Statement of the General Objects, &c., of the Society, of Chemical, Botanical, and Veterinary Privileges, and of other printed papers connected with special departments of the Society's business.

Members' Veterinary Privileges.

I.—Visits of the Veterinary Inspector.

1. Any Member of the Society who may desire professional attendance and special advice in cases of disease among his cattle, sheep, or pigs, should apply to the Secretary of the Society, or to the Principal of the Royal Veterinary College, and Consulting Veterinary Surgeon, Camden Town, London, N.W.

2. The remuneration of the Consulting Veterinary Surgeon or Inspector will be 2*l.* 2*s.* each day as a professional fee, and the charge for personal expenses, *when such have been incurred*, will in no case exceed one guinea per diem. He will also be allowed to charge the cost of travelling to and from the locality where his services may have been required. These charges may, however, in cases of serious or extensive outbreaks of contagious disease, be reduced or remitted altogether, so far as the Members of the Society are concerned, at the discretion of the Council, on such step being recommended to them by the Veterinary Committee.

3. The Inspector, on his return from visiting the diseased stock, will report to the Member, and, through the Principal of the Royal Veterinary College, to the Committee, in writing, the results of his observations and proceedings, which Report will be laid before the Council.

4. When contingencies arise to prevent a personal discharge of the duties, the Consulting Veterinary Surgeon may, subject to the approval of the Committee, name some competent professional person to act in his stead, who shall receive the same rates of remuneration.

II.—Consultations without Visit.

Personal consultation with Veterinary Inspector	10*s.* 6*d.*
Consultation by letter	10*s.* 6*d.*
Post-mortem examination, and report thereon ..	21*s.*

A return of the number of applications from Members of the Society during each half-year is required from the Veterinary Inspector.

III.—Admission of Diseased Animals to the Royal Veterinary College, Camden Town, N.W.; Investigations and Reports.

1. All Members of the Society have the privilege of sending cattle, sheep, and pigs to the Infirmary of the Royal Veterinary College, on the following terms; viz., by paying for the keep and treatment of cattle 10*s.* 6*d.* per week each animal, and for sheep and pigs, 3*s.* 6*d.* per week.

2. A detailed Report of the cases of cattle, sheep, and pigs treated in the Infirmary of the College, or on Farms in the occupation of Members of the Society, will be furnished to the Council quarterly; and also special reports from time to time on any matter of unusual interest which may come under the notice of the Officers of the College.

By Order of the Council,

H. M. JENKINS, *Secretary.*

Members' Privileges of Chemical Analysis.

(Applicable only to the case of Persons who are not commercially engaged in the manufacture or sale of any substance sent for Analysis.)

The Council have fixed the following rates of Charges for Analysis to be made by the Consulting Chemist for the *bonâ-fide* and sole use of Members of the Society; who, to avoid all unnecessary correspondence, are particularly requested, when applying to him, to mention the kind of analysis they require, and to quote its number in the subjoined schedule. The charge for analysis, together with the carriage of the specimens (if any), must be paid to him by Members at the time of their application:

No. 1.—An opinion of the genuineness of bone-dust or oil-cake (each sample)	2*s*. 6*d*.
„ 2.—An estimate of the value (relatively to the average samples in the market) of sulphate and muriate of ammonia and of the nitrates of potash and soda	5*s*.
„ 3.—An analysis of guano; showing the proportion of moisture, organic matter, sand, phosphate of lime, alkaline salts and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it	10*s*.
„ 4.—An analysis of mineral superphosphate of lime for soluble phosphates only, and an estimate of its value, provided the selling price of the article to be analysed be sent with it ..	5*s*.
„ 5.—An analysis of superphosphate of lime, showing the proportions of moisture, organic matter, sand, soluble and insoluble phosphates, sulphate of lime, and ammonia, and an estimate of its value, provided the selling price of the article to be analysed be sent with it	10*s*.
„ 6.—An analysis, showing the value of bone-dust or any other ordinary artificial manure, provided the selling price of the manure to be analysed be sent with it	10*s*.
„ 7.—An analysis of limestone, showing the proportion of lime ..	7*s*. 6*d*.
„ 8.—An analysis of limestone, showing the proportion of magnesia, 10*s*.; the proportion of lime and magnesia	10*s*.
„ 9.—An analysis of limestone or marls, showing the proportion of carbonate, phosphate, and sulphate of lime and magnesia, with sand and clay	10*s*.
„ 10.—Partial analysis of a soil, including determinations of clay, sand, organic matter, and carbonate of lime	10*s*.
„ 11.—Complete analysis of a soil	£3
„ 12.—An analysis of oil-cake or other substance used for feeding purposes, showing the proportion of moisture, oil, mineral matter, albuminous matter, and woody fibre, as well as of starch, gum, and sugar in the aggregate; and an opinion of its feeding and fattening or milk-producing properties ..	10*s*.
„ 13.—Analysis of any vegetable product	10*s*.
„ 14.—Analysis of animal products, refuse substances used for manures, &c.	from 10*s*. to £1
„ 15.—Determination of the "hardness" of a sample of water before and after boiling	5*s*.
„ 16.—Analysis of water of land-drainage, and of water used for irrigation	£1
„ 17.—Analysis of water used for domestic purposes	£1 10*s*.
„ 18.—Determination of nitric acid in a sample of water	10*s*.
„ 19.—Examination of Viscera for Metallic poison	£2 2*s*.
„ 20.—Examination of Viscera complete, for metals and alkaloids	£5 5*s*.
„ 21.—Personal consultation with the Consulting Chemist. (The usual hours of attendance for the Director, Monday excepted, will be from 11 to 2, but to prevent disappointment, it is suggested that Members desiring to hold a consultation with the Director should write to make an appointment) ..	5*s*.
„ 22.—Consultation by letter	5*s*.
„ 23.—Consultation necessitating the writing of three or more letters	10*s*.

The Laboratory of the Society is at 12, Hanover Square, London, W., to which address the Consulting Chemist, Dr. Augustus Voelcker, F.R.S., requests that all letters and parcels (postage and carriage paid) from Members of the Society, who are entitled to avail themselves of the foregoing Privileges, should be directed.

GUIDE TO THE PURCHASE OF ARTIFICIAL MANURES AND FEEDING STUFFS.

FEEDING CAKES.

1. *Linseed-cake* should be purchased as "Pure," and the insertion of this word on the invoice should be insisted upon. The use of such words as "Best," "Genuine," &c., should be objected to by the purchaser.

2. *Rape-cake for feeding purposes* should be guaranteed "Pure" and purchased by sample.

3. *Decorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

4. *Undecorticated Cotton-cake* should be guaranteed "Pure," and purchased by sample.

N.B.—All feeding cakes should be purchased in good condition, and the guarantee of the vendor should be immediately checked by a fair sample (taken out of the middle of the cake) being at once sent for examination to a competent analytical chemist. The remainder of the cake from which the sample sent for examination had been taken should be sealed up in the presence of a witness, and retained by the purchaser for reference in case of dispute.

ARTIFICIAL MANURES.

1. *Raw or Green Bones or Bone-dust* should be purchased as "Pure" Raw Bones guaranteed to contain not less than 45 per cent. of tribasic phosphate of lime, and to yield not less than 4 per cent. of ammonia.

2. *Boiled Bones* should be purchased as "Pure" Boiled Bones guaranteed to contain not less than 48 per cent. of tribasic phosphate of lime, and to yield not less than 1¾ per cent. of ammonia.

3. *Dissolved Bones* are made of various qualities, and are sold at various prices per ton; therefore the quality should be guaranteed, under the heads of *soluble* phosphate of lime, *insoluble* phosphate of lime, and nitrogen or its equivalent as ammonia. The purchaser should also stipulate for an allowance for each unit per cent. which the dissolved bones should be found on analysis to contain less than the guaranteed percentages of the three substances already mentioned.

4. *Mineral Superphosphates* should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of *soluble* phosphate of lime, at a certain price per unit per cent., no value to be attached to *insoluble* phosphates.

5. *Compound Artificial Manures* should be purchased in the same manner and with the same guarantees as Dissolved Bones.

6. *Nitrate of Soda* should be guaranteed by the vendor to contain from 94 to 95 per cent. of pure nitrate.

7. *Sulphate of Ammonia* should be guaranteed by the vendor to contain not less than 23 per cent. of ammonia.

8. *Peruvian Guano* should be sold under that name, and guaranteed to be in a dry and friable condition, and to contain a certain percentage of ammonia.

N.B.—Artificial manures should be guaranteed to be delivered in a sufficiently dry and powdery condition to admit of distribution by the drill. A sample for analysis should be taken, not later than three days after delivery, by emptying several bags, mixing the contents together, and filling two tins holding about half a pound each, in the presence of a witness. Both the tins should be sealed, one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES FOR ANALYSIS.

ARTIFICIAL MANURES.—Take a large handful of the manure from three or four bags, mix the whole on a large sheet of paper, breaking down with the hand any lumps present, and fold up in tinfoil, or in oil-silk, about 3 oz. of the well-mixed sample, and send it to 11, Salisbury Square, Fleet Street, E.C., by post: or place the mixed manure in a small wooden or tin box, which may be tied by string, but must not be sealed, and send it by post. If the manure be very wet and lumpy, a larger boxful, weighing from 10 to 12 oz., should be sent either by post or railway.

Samples not exceeding 4 oz. in weight may be sent by post, by attaching two penny postage stamps to the parcel.

Samples not exceeding 8 oz., for three postage stamps.

Samples not exceeding 12 oz., for four postage stamps.

The parcels should be addressed: Dr. Augustus Voelcker, 11, Salisbury Square, Fleet Street, London, E.C., and the address of the sender or the number or mark of the article be stated on parcels.

The samples may be sent in covers, or in boxes, bags of linen or other materials. No parcel sent by post must exceed 12 oz. in weight, 1 foot 6 inches in length, 9 inches in width, and 6 inches in depth.

SOILS.—Have a wooden box made 6 inches long and wide, and from 9 to 12 inches deep, according to the depth of soil and subsoil of the field. Mark out in the field a space of about 12 inches square; dig round in a slanting direction a trench, so as to leave undisturbed a block of soil with its subsoil from 9 to 12 inches deep; trim this block or plan of the field to make it fit into the wooden box, invert the open box over it, press down firmly, then pass a spade under the box and lift it up, gently turn over the box, nail on the lid and send it by goods or parcel to the laboratory. The soil will then be received in the exact position in which it is found in the field.

In the case of very light, sandy, and porous soils, the wooden box may be at once inverted over the soil and forced down by pressure, and then dug out.

WATERS.—Two gallons of water are required for analysis. The water, if possible, should be sent in glass-stoppered Winchester half-gallon bottles, which are readily obtained in any chemist and druggist's shop. If Winchester bottles cannot be procured, the water may be sent in perfectly clean new stoneware spirit-jars surrounded by wickerwork. For the determination of the degree of hardness before and after boiling, only one quart wine-bottle full of water is required.

LIMESTONES, MARLS, IRONSTONES, AND OTHER MINERALS.—Whole pieces, weighing from 3 to 4 oz., should be sent enclosed in small linen bags, or wrapped in paper. Postage 2*d.*, if under 4 oz.

OILCAKES.—Take a sample from the middle of the cake. To this end break a whole cake into two. Then break off a piece from the end where the two halves were joined together, and wrap it in paper, leaving the ends open, and send parcel by post. The piece should weigh from 10 to 12 oz. Postage, 4*d.* If sent by railway, one quarter or half a cake should be forwarded.

FEEDING MEALS.—About 3 oz. will be sufficient for analysis. Enclose the meal in a small linen bag. Send it by post.

On forwarding samples, separate letters should be sent to the laboratory, specifying the nature of the information required, and, if possible, the object in view.

POISONS.—Before a chemical examination is undertaken, a post-mortem should be made by a Veterinary Surgeon, or at the Royal Veterinary College, Camden Town, N.W., and only the necessary Viscera should be sent to the Laboratory for analysis, with a report on the post-mortem.

H. M. JENKINS, *Secretary.*

Members' Botanical and Entomological Privileges.

The Council have fixed the following Rates of Charge for the examination of Plants, Seeds, and Insects for the *bonâ fide* use of Members of the Society, who are particularly requested, when applying to the Consulting Botanist, to mention the kind of examination they require, and to quote its number in the subjoined Schedule. The charge for examination must be paid to the Consulting Botanist at the time of application, and the carriage of all parcels must be prepaid.

I. BOTANICAL.

No. 1.—A report on the purity, amount and nature of foreign materials, perfectness, and germinating power of a sample of seeds	5s.
„ 2.—Detailed report on the weight, purity, perfectness, and germinating power of a sample of seeds, with a special description of the weeds and other foreign materials contained in it	10s.
„ 3.—Determination of the species of any weed or other plant, or of any epiphyte or vegetable parasite, with a report on its habits, and the means of its extermination or prevention	5s.
„ 4.—Report on any disease affecting the farm crop	5s.
„ 5.—Determination of the species of a collection of natural grasses found in any district on one kind of soil, with a report on their habits and pasture value	10s.

II. ENTOMOLOGICAL.

„ 6.—Determination of the species of any insect, worm, or other animal which, in any stage of its life, injuriously affects the farm crops, with a report on its habits and suggestions as to its extermination	5s.

INSTRUCTIONS FOR SELECTING AND SENDING SAMPLES.

In sending seed or corn for examination the utmost care must be taken to secure a fair and honest sample. If anything supposed to be injurious or useless exists in the corn or seed, selected samples should also be sent.

In collecting specimens of plants, the whole plant should be taken up, and the earth shaken from the roots. If possible, the plants must be in flower or fruit. They should be packed in a light box, or in a firm paper parcel.

Specimens of diseased plants or of parasites should be forwarded as fresh as possible. Place them in a bottle, or pack them in tinfoil or oil-silk.

All specimens should be accompanied with a letter specifying the nature of the information required, and stating any local circumstances (soil, situation, &c.) which, in the opinion of the sender, would be likely to throw light on the inquiry.

N.B.—*The above Scale of Charges is not applicable in the case of Seedsmen requiring the services of the Consulting Botanist.*

Parcels or letters (Carriage or Postage prepaid) to be addressed to Mr. W. Carruthers, F.R.S., 4, Central House, Central Hill, Norwood, S.E.

H. M. JENKINS, *Secretary.*

New York Botanical Garden Library
3 5185 00330 0041